TRUCK COMPANY OPERATIONS

A MANUAL FOR THE CFD FIREFIGHTER

Adapted Version for the 2025 CSC Fire Promotional Exams

Revised 08/30/21

TRUCK COMPANY OPERATIONS

Riding on a CFD Ladder Company is a privilege. A privilege that every firefighter on CFD gained when they graduated the training academy. With that privilege comes a lot of responsibility. In this manual, you will learn your responsibilities when riding on a CFD Ladder Company. You will learn the roles and duties of each riding position on the ladder company. Part of being a Columbus Firefighter requires you to know and be able to effectively execute all riding positions on every truck. Granted, there may be more desirable positions on certain trucks, but the responsibility of the firefighter stays the same. The CFD Ladder Company is no different. Some may view being the tiller driver, or the inside firefighter, or even the officer as the best position, but they are all equally important. If one fails at successfully executing the tasks associated with each position, the crew fails. This manual will help teach you the tactics of each position to ensure success.

To become what some senior firefighters refer to as a "Trucker" requires determination, hard work, training, and self-motivation. Not everyone assigned to a ladder is considered a "Trucker." This title is only inferred when one possesses the drive and desire to become truly exceptional at their craft. It also takes experience on all types of emergency scenes. This experience will help the ladder company firefighter apply the appropriate skills at the appropriate time, thus ensuring success on the scene. The Columbus Division of Fire has been truly blessed to have amongst its members those that possess this drive and determination to not only excel at their craft, but to help others excel as well. This manual has taken the input passed down by generations of "Truckers", who not only wanted to do their best, but also wanted to share that knowledge so others could carry on that legacy.

This manual was created to help guide Columbus Firefighters as they progress through their apprenticeship training. However, this book is not limited to apprenticeship training. It has been designed as reference material for **all** members of the department. The information within this manual has been gathered from past experiences, manufacturer manuals, calculations, and previous training. The most important of these sources is the experiences shared by past and present members of the Columbus Fire Department. Their successes, and equally important, their failures, have been used to construct this manual so that you can better understand your role on a CFD Ladder Company.

In the first section of the manual, you will find experiences shared by current and retired CFD members. These stories have been shared to allow you to learn from their experiences, good or bad, and to help you make your own decisions when the time comes. The fire service is an experience-based job; unfortunately, there is no substitute for experience. We should pay close attention to what others have learned as we strive to work hard and train day in and day out.

Moving into the second section of the manual, you will find CFD standard operating procedures (SOPs). The SOPs pertain to the ladder company's actions at fire scenes and other emergency scenes. You should take time to understand these SOPs, as they are a guideline to aid your initial actions as well as work with other companies during an emergency response. It is important to understand that SOPs should be followed if at all possible. However, it is also impossible to create an SOP for every situation you encounter on this job. Some decisions must be guided by experience and what the situation presents to you.

The third section will cover the tools and equipment carried on CFD ladder companies. The equipment section is designed to help you become more familiar with CFD ladder company tool uses. The fourth section will cover care and maintenance for that equipment. CFD provides us with a great complement of resources and equipment. It is our responsibility to be proficient in their use and capabilities.

The fifth section will provide you with information on the different makes and models of Ladder Trucks that CFD has in its fleet. It won't teach you every single detail about each truck, because that would be nearly impossible. It will give you the information needed to be able to set-up and short-jack each type of ladder truck in the fleet, and some of the important things you should keep in mind when operating a certain type of ladder truck.

The sixth section of this manual will inform you about the responsibilities of the different riding positions on the truck company. When riding on a ladder company, job functions are broken down by what position you are riding on the truck.

The seventh and subsequent sections of this manual will discuss the multiple tasks that the truck company is/could be responsible for. These sections will make up a large portion of this manual.

The final section of the manual will contain both hands-on skill sheets and teach-back topics. These skills are not just for apprentice firefighters, but for the veteran firefighter as well. You can never train too much for a job that can kill you. Don't ever feel like you are inconveniencing someone else by becoming better at your job. There are plenty of skills that a firefighter riding a truck company should stay proficient at, and you won't become proficient at them by sitting in the recliner. Train, learn, and share any knowledge that you feel someone else should know.

Finally, we want you to understand that this manual is not set in stone. It can and will be changed as our department continues to learn new ideas and techniques. If there is something you do not understand, ask. The greatest thing about CFD is the amazing people that work for it. Our membership is our most valuable resource. Please pass on what you have learned, as this is the life blood of the fire service.

Respectfully,
Captain Sexton Towns

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SECTION OBJECTIVES

Understand the process for checking equipment during truck checks	Understand the specifications and uses of the Honda Generator EU1000i/2000i
Understand the specifications and uses of the Stihl MSA 220 C Chainsaw	Understand the specifications and uses of the Honda Generator EB 5000X/EM 6500 SX
Understand the specifications and uses of Stihl MS 046, 460, and 461R Chainsaws	Understand the specifications and uses for various adapters, cords, and lights
Understand the specifications and uses of Stihl TS400 and 700 Series Circular Saws	Understand the specifications and uses of RAMFANS and smoke ejectors
Understand the specifications and uses of Stihl MS and TS 500i Fuel Injected Saws	Understand the specifications of the Columbus rope bag
Understand how to maintain ground ladders	Understand the specifications and uses for the rabbit tool and the Hydra-Ram II

EQUIPMENT CHECKS

OVERVIEW

Everyone on CFD knows that after roll call, firefighters first place their PPE on the truck, then do equipment checks. This section covers some specific suggestions for checking the equipment on ladder trucks. Some of these suggestions may be new, and some suggestions will be things firefighters already do every shift. Checking the equipment on the truck is a very important part of every firefighter's day, and it is something that must be taken seriously. Firefighter and civilian lives may depend on the readiness of these tools.

Most CFD ladder companies carry the same complement of tools, with an additional tool here and there that crews have gotten on their own. It is the crew's job to make sure those tools are functioning properly; when the time comes there must be no doubt that the tools are ready to get the job done. Each firefighter will develop their own method of checking the various apparatus and equipment in the Division. Newly assigned firefighters can seek the help of more senior assigned firefighters at their station to help familiarize them with the truck during their initial checks.

Listening to the off-going crew's pass on report can also be helpful when performing morning checks. These reports can help inform oncoming firefighters of any equipment that was used, is broken, or is currently missing. A thorough check of all equipment should always be done. However, if the off-going crew reports a busy shift with a significant incident (especially structure fires), firefighters should increase their attentiveness during the check.

PPE AND SCBA

During equipment checks in the morning, most companies start off by checking their own personal PPE and SCBA. All firefighters, including the ladder driver and Tiller/OSV firefighter, should be checking their PPE and SCBA. This equipment is designed to protect firefighters; every firefighter must take the time to make sure it is working correctly. Below is a short list of some of the actions firefighters should be taking in the morning when checking their gear:

- Put on the face piece and breathe air from the MMR
- Check the PASS device; let it cycle through all the alarms
- Check the purge valve, control module, and the Vibra-Alert
- Make sure the SCBA straps are placed appropriately for easy donning
- Make sure the SCBA cylinder is **completely full at 5500 PSI**
- Make sure each piece of gear is set-up as desired
- Portable radios should be checked to make sure the battery is full
    - Many firefighters set their portable radio to the fireground that they would respond on if the fire was across the street from the fire house. This removes any unnecessary steps when responding to a fire close to the station

HAND TOOLS

While working on ladder companies, a majority of incidents firefighters respond to will involve carrying some type of hand tools. Most CFD ladder companies have hand tools safely stored in the cab, allowing crews to come off the truck ready for work. Remember, the ladder crew's number one concern is life safety; seconds count when possible victims are inside a structure fire. Which tools are carried in the cab depends on what each specific ladder company has decided on. If firefighters are TT'd in for the day and the tool they prefer to carry is not in the cab, they should ask the officer on the truck what he/she prefers for them to carry.

During equipment checks, firefighters should be checking the truck to ensure the hand tools are in their proper storage location, are clean, and are in good working order. If a firefighter sees that an axe head is loose, get it exchanged at Tools and Equipment. If the adz on the Halligan needs to be sharpened or has burrs, firefighters should get out a file and hone it. If a piece of equipment is dirty from a fire the previous shift had the night before, clean it. The city does a great job of allowing the Division to buy nice equipment; all firefighters should do their part to ensure this equipment is maintained and ready at all times. The list below shows what should be checked on various pieces of equipment:

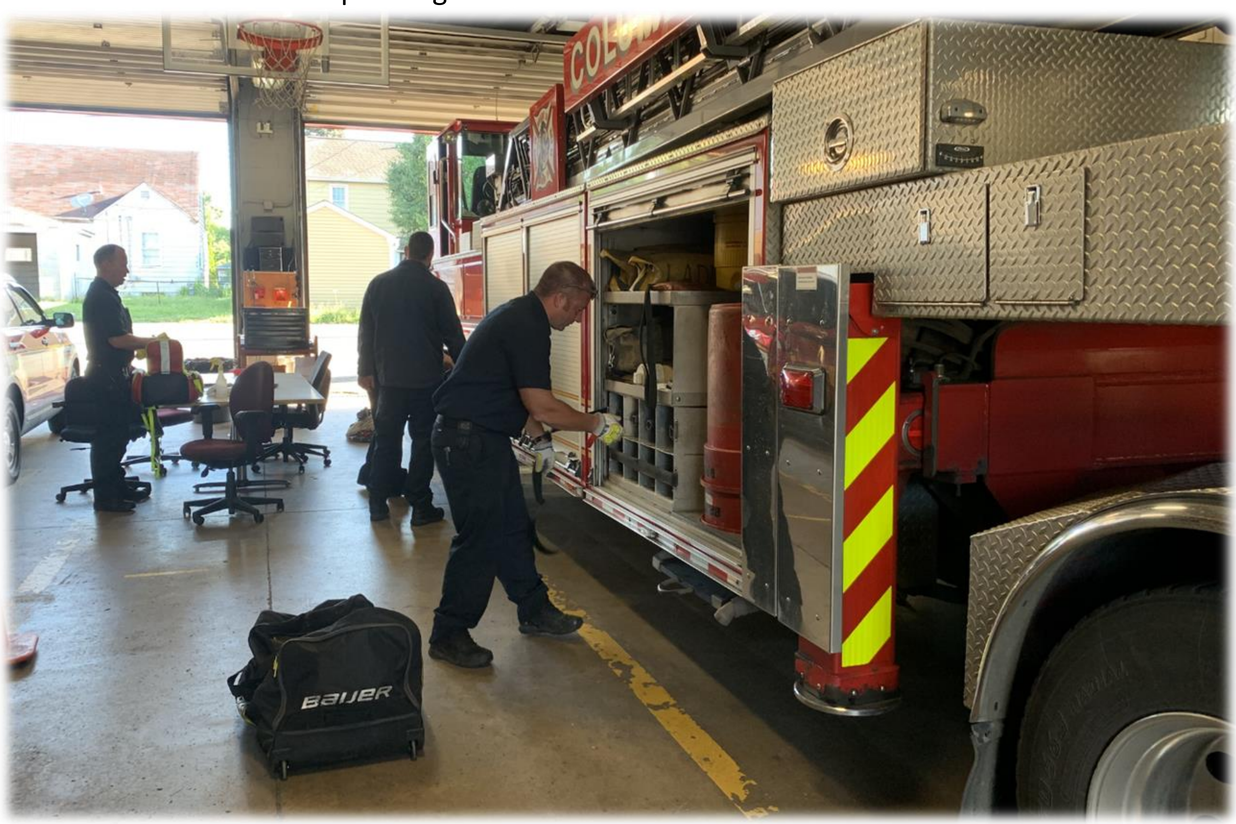
- **Sledge hammer—**Inspect the head and the handle. The striking surface should be wiped with a light oil to protect from rust. Handles should be checked for any chips or cracks
- **Axe—**Check the cutting surface for nicks or dings. Use a file and hone to sharpen the surface. Check the striking surface for any big chips or dings. Check for mushroomed metal; if any is found, use a file to clean up the striking surface. Handles should be checked for any chips or cracks
- **Halligan—**Pick should be tapered and sharp. The adz should be sharp with no damaged metal; use a file to remove any burrs. The forks should also be sharp
- **Pike Poles—**Make sure they are clean. The heads should be lightly oiled (photos below)
- **Rope Bags—**Make sure the length is labeled on the bag. Inspect the rope after each use
- **Water Can—**Ensure the can is pressurized to its proper range and feels like it has the appropriate amount of water in it
- **Battery Lights—**Ensure hand lights are stored properly and charging. Milwaukee lights should have a full charge

COMPARTMENT CHECKS

The majority of the equipment on the ladder truck is carried in one of the many compartments on the trucks. All this equipment should be checked daily. Each crew and firehouse will have a specific manner in which they check the truck. Some crews may have assigned compartments or equipment they are responsible for checking individually; others may work around the truck as a group. When checking a compartment, first look to ensure that all the equipment that is normally in the compartment is present. Firefighters who are checking the truck for the first time might need an equipment list or a firefighter who knows that truck to look over the truck with them.

After ensuring all the correct equipment is within the compartment, make sure the equipment is clean and in good working order. Equipment that has a motor on it should be started and operated to see if it is working properly, along with topping off the fuel. Firefighters should ensure they are running gas powered equipment outside or with proper ventilation in place. Battery powered equipment should be checked for proper function and to ensure the batteries are fully charged. If a firefighter finds a tool they are unfamiliar with, they should ask the assigned crew to go over the tool with them to give them an understanding of its uses and to ensure they can operate it if needed. The scene of an emergency should not be the first time a firefighter has taken a tool off the truck.

The next few pages will give some specific examples and considerations when checking various pieces of equipment on the ladder. This is certainly not an all-inclusive list, but it can be helpful for firefighters not normally assigned to a ladder company. More in-depth information can be found in each tool's corresponding section of this manual.



PPV Fans—Start them daily; make sure no trash or plastic is on the fan. Firefighters should make sure they are familiar with how to adjust the angle on the fans.

Battery Powered Tools—Make sure all the battery packs are fully charged. Any tool on the truck that is powered by a battery should be checked to ensure it is working properly.

Salvage Kits—Make sure that the proper tools are in the kit (Normally staplers, utility knives, window plastic, and salvage plastic). Make sure the staple guns are loaded correctly and not jammed.

Portable Light—Check all lights to ensure the bulbs are working and are not damaged. Quartz lights can be checked in conjunction with cord reels and extension cords to make sure those are working as well. Check to see if the light will hold the position it is set to.

Circular Saw—Make sure the blade is on correctly and the nuts are tight. Check the blade and replace it if needed. Start the saw and allow it to reach its operating temperature (about 5 minutes).

Portable Generators—Start it and place a load on it by using it to power a fan or light with it. Make sure generators are started and stopped with no load. The auto throttle function (if equipped) should be left off until the generator engine has had time to warm up. The photo below shows the auto throttle in the off position.

Chain Saws—Make sure the chain is on correctly and that it has the correct tension. Make sure the chain does not have too many missing teeth. Start the saw and allow it to reach its operating temperature (about 5 minutes). When left running, a towel placed under the saw can reduce vibrations and prevent damage to the saw over time.

Box Fan—Start box fans daily. Firefighters should make sure they are familiar with how to use the fan hanger.

Extra SCBA Bottles—Make sure they are at 5500 PSI. If it is at 5,000 PSI, do not be lazy; go top it off.

Platform Ladder—Make sure there is a pike pole (8 ft. minimum) in the fly section and there is an axe in the bucket. Check to ensure the emergency stop switch (photo below) is disengaged. Make sure the nozzles and water curtain are closed.

Ground Ladders—Make sure the dogs and pawls are locked and that the ladders are oriented on the truck how your company wants them (Right or left shoulder carry). Check the halyard. If pike poles are attached to the ladders, make sure the straps on them are tight, and make sure the pike pole is closer to the door.

Aerial Ladder (Tiller)—Make sure there is a pike pole (8 ft. minimum) and an axe at the tip. Make sure the waterway is in rescue mode, and make sure the waterway intakes are closed on both sides.

STIHL MSA 220 C CHAINSAW

IDENTIFICATION AND GENERAL SPECIFICATIONS

- Newest saw in the Division, designed to replace the electric corded Stihl chainsaws
- 3 basic components—12" guide bar, chain, and battery pack
- Electric motor driven
- AP 300 S Battery
  - 1 solid red LED—battery is too hot/too cold
  - 4 flashing red LEDs—bad battery (faulty)
  - 3 solid red LEDs—chainsaw is too hot
  - 3 flashing red LEDs—chainsaw malfunction (electronics/motor)
  - Remove the battery when changing the chain or performing maintenance
- 7.1 oz. bar oil reservoir
- Weighs roughly 6.4 lbs. (without the battery)

CHAIN SPECIFICATIONS

- Information stamped on the guide bar of the saw
- Carbide toothed chain
- 3/8" PICCO (Pitch: distance from one drive link to the next, divided by two)
  - The larger the pitch, the heavier/bigger the chain
  - Stamped on the raker with a "6"—Indicating 3/8" pitch
- .050" gauge (Width of the drive link)
  - Stamped on the drive link/tang with a "3"—Indicating .050" gauge
- 44 drive links; 22 cutting teeth (If 3 or more teeth are missing, replace the chain)

WHEN TO USE

- Overhaul
- RIT scenarios
- Plywood on vacant structures
- Clearing trees/limbs for access
- Anywhere internal combustion saws will not run

ADVANTAGES/DISADVANTAGES

- Speed and ease of use—quick to place into service
- Not subject to flooding like a traditional saw
- Ability to operate in a smoke-filled environment
- Does not have the same power compared to the Division's larger internal combustion saws. Firefighters cannot expect this saw to operate at the same capacity as those. They are different saws, each with their own advantages and disadvantages

[Training Video 1: Saw Info]
[Training Video 2: Bar and Chain]
[Training Video 3: Assembly and Chain]
[Training Video 4: Bar Oil and Basic Care]
[Training Video 5: Tips and Troubleshooting]
[Training Video 6: Safety Tips and Extra Info]

STIHL MS 046, 460, AND 461R CHAINSAWS

IDENTIFICATION AND GENERAL SPECIFICATIONS

- 460/461—R refers to wraparound handle and larger starter grip
- 3 basic components—guide bar, chain, and powerhead
- Two-stroke engine
- Fuel mix ratio of 50:1 (2.6 fl oz. of oil to 1 gallon of gasoline)
- No more than 10% ethanol
- 20" guide bar
- 27 oz. fuel reservoir; 11 oz. bar oil reservoir
- Weighs roughly 15 lbs. (Powerhead only)

CHAIN SPECIFICATIONS

- Information stamped on the guide bar of the saw
- Carbide toothed chain
- 3/8" PICCO (Pitch: Distance from one drive link to the next, divided by two)
    - The larger the pitch, the heavier/bigger the chain
- .050" gauge (Width of the drive link)
- 72 drive links
- 36 cutting teeth (If three or more are missing, replace the chain)
- Green drive link = low kick back chain; yellow drive link = more aggressive chain

WHEN TO USE

- Roof ventilation
- Window cutdowns
- RIT scenarios
- Clearing large trees/limbs
- Cutting wooden garage doors
- Plywood on a vacant structure

GENERAL CARE/MAINTENANCE GUIDELINES

- Fully choke the saw when disassembling for cleaning
- Turn the guide bar over after each use to promote even wear (Use a single cut file to file down burrs if necessary)
- When starting the saw for morning checks, allow the saw to run for 2 to 5 minutes to reach the proper operating temperature

ADVANTAGES/DISADVANTAGES

- Versatile saw with large cutting depth (16")
- Requires regular maintenance and care for proper operation (Carbureted)
- Internal combustion engine requires fresh, clean air to run (will not run in heavy smoke)

STIHL TS400 AND 700 SERIES CIRCULAR SAW

IDENTIFICATION AND GENERAL SPECIFICATIONS

- 3 basic components—arm, blade, and powerhead
- Two-stroke engine
- Fuel mix ratio of 50:1 (2.6 fl oz. of oil to 1 gallon of gasoline)
- No more than 10% Ethanol; minimum 89 octane
- Max spindle speed—5,350 RPM
- Weights range between 21 and 26 lbs.

BLADE SPECIFICATIONS

- 12-inch blades have a max cutting depth of 3.9”
- 14-inch blades have a max cutting depth of 4.9”
- Composite blades come in two different types, metal or masonry
    - Inspect for chemical damage, deterioration, and fraying
- Dax blades—cuts metal up to 3/16” thick; multipurpose blade with carbide cutting teeth
    - Inspect for missing teeth, cracks, and fissures
- Diamond blade—cuts metal/concrete
    - Check for missing diamond bits, mushrooming on heads, and cracks or fissures

GENERAL CARE/MAINTENANCE GUIDELINES

- Fully choke the saw when disassembling for cleaning
- Inspect the blade frequently after each use and change when needed
- When starting the saw for morning checks, allow the saw to run for 2 to 5 minutes to reach the proper operating temperature

WHEN TO USE

- Roof ventilation
- Rebar and thicker metal
- RIT scenarios
- Masonry work
- Garage doors
- Vacant, boarded-up structures

ADVANTAGES OF 700

- The 700 is the most powerful circular saw the Division currently has
- Large blade ensures deeper cut depth for user

DISADVANTAGES OF 700

- Larger saw = more gyroscopic effect when cutting. Outboard operations are not recommended
- The weight and size of the saw makes it difficult to handle in odd positions, such as a firefighter cutting above their head

STIHL MS AND TS 500i FUEL INJECTED SAWS

OVERVIEW

- The Stihl MS 500i chainsaw and the Stihl TS 500i circular saw are fuel-injected saws that have been newly acquired by the Division
- Many of the basic components of the saws are the same as the non-fuel injected saws
- The main difference is the injection system and the electronics
- **<u>It is highly recommended that all firefighters read the associated manuals for each unit linked below.</u>** This sheet is only a basic introduction to the equipment

MS 500i CHAINSAW INFORMATION

<u>Click here to view Stihl MS 500i Chainsaw Manual</u>

- 20” bar, 72 drive links, 36 teeth
- Displacement—4.83 cu. in.
- Idle speed—3,000 RPM
- Max engine speed—13,700 RPM
- Fuel—50:1 mixed ratio
- Start-up procedures
    - Engage the chain brake
    - Remove the scabbard
    - Press the decompression valve
    - Press the manual fuel pump bulb at least 8 times
    - Hold the saw firmly and pull the starter grip
    - Do not let the starter grip snap back or fully extend it
    - Once the saw is running, it is now ready

<u>Click here to view Stihl MS 500i Chainsaw Injection Video</u>

TS 500i CIRCULAR SAW INFORMATION

- 14-inch blade—4.9” max cutting depth
- Displacement—4.41 cu. in.
- Idle speed—2,500 RPM
- Max engine speed—9,000 RPM
- Spindle Speed—5,350 RPM
- Fuel—50:1 mixed ratio
- Start-up procedures
    - Press the throttle trigger lockout and throttle trigger simultaneously
    - Move the stop switch to (I)
    - Release the throttle trigger, stop switch, and throttle trigger lockout in succession—this is the starting throttle position
    - Press the decompression valve
    - Press the manual fuel pump bulb 7-10 times
    - Hold the saw firmly and pull the starter grip
    - Do not let the starter grip snap back or fully extend it
    - Once the saw is running, blip the throttle. The saw is now ready

<u>Click here to view Stihl TS 500i Circular Saw Injection Video</u>
<u>Click here to view Stihl TS 500i Circular Saw Manual</u>

GROUND LADDERS

OVERVIEW

- CFD uses aluminum ground ladders, manufactured by Duo-Safety Ladder Corporation
- All extension ladders and roof ladders meet NFPA specifications
- For more information about ground ladders, see the Laddering the Structure section in this manual

NFPA RATINGS AND STANDARDS

- Tools and Equipment performs annual service testing of extension and roof ladders in October every year to ensure they meet NFPA 1931 standards
- All extension ladders and roof ladders meet the following NFPA specifications:
    - Rungs load tested—1,000 lbs.
    - Rung spacing—14 inches
    - Weight rating—750 lbs with a 4:1 safety factor
    - Minimum width between ladder beams—16 inches
- Specialty ladders including the folding Attic Ladder, Fresno Ladder, and Little Giant Combination Ladder do not conform to NFPA 1931 or 1932

CARE AND MAINTENANCE

- The halyard should be inspected after each use. If the halyard is in good condition but adjustments are necessary, the halyard can be retied at the station. For a broken or damaged halyard, take it out of service and contact Tools and Equipment for replacement
- Using a mild detergent and soft bristle brush is sufficient for most cleaning. If needed, a generic lubricant such as WD-40 can be used in moderation on moving parts such as springs on hooks, attic ladders, etc.
- No ladder should require more than 75 lbs of force to raise. If it feels like more than this, the ladder should be immediately cleaned and waxed
    - Bar wax can be obtained from supply and applied liberally to the bed and fly section
    - Wax ladders every 6 months at a minimum; this can be adjusted based on usage rates

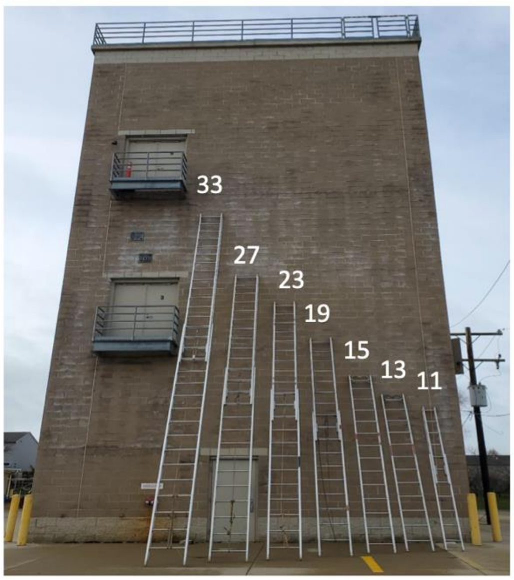
HEAT SENSOR LABELS

- Visual warning labels are located on all aluminum ladders; four labels per ladder section
- These labels turn black if any heat greater than 300° F is present
- Once the aluminum ladder material (6061-T6 alloy) reaches 300° F, the ladder could lose at least 25% of its load capacity
- If a black sensor is found, take the ladder out of service and contact Tools and Equipment

COMMON LADDER COMPLEMENTS

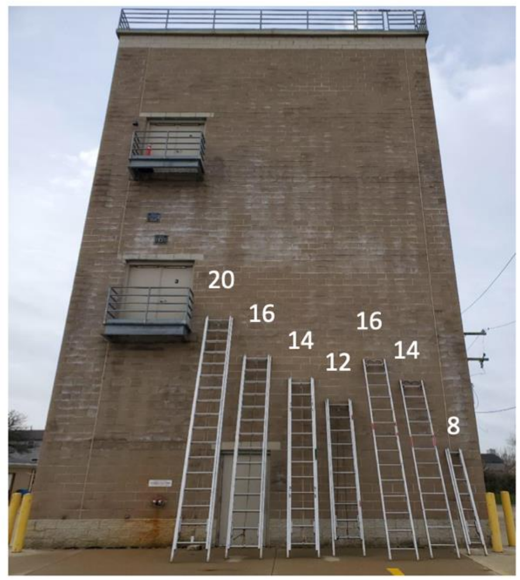
- Ladder complements will vary from one truck to another. The images below show an example of a common ladder complement that can be found throughout the Division
- Columbus Fire does not carry any ground ladder over 35’, which by NFPA standard would require “tormentor” or “bangor” poles for lateral stabilization
- Currently Tools and Equipment is ordering 2-section extension ladders. Previously, due to how ladders were stored on the SP model of Sutphen Platforms, 35’ extension ladders were ordered with 3-sections

REACH



35 28 24 20 16 14 12

BEDDED



35 28 24 20 16 14 12

Ladder Size	Weight	Engines	Ladders
Fresno	30 lbs	-	1
10’ Attic	16 lbs	1	1
14’ Roof	28 lbs	1	1
16’ Roof	39 lbs	-	1
20’ Extension	60 lbs	-	1
24’ Extension	72 lbs	1	2
28’ Extension	87 lbs	-	1
35’ Extension 2 fly	122 lbs	-	1
35’ Extension 3 fly	129 lbs	-	-

HONDA GENERATOR EU1000i/2000i

SPECIFICATIONS EU1000i

- Engine—Honda GX100
- Displacement: 3.01 cu in.
- AC output: 120-volt, 1000-watt maximum, 900-watt rated
- Oil type and capacity: 10W-30 8oz
- Fuel tank capacity—.55 gallon
- Run time per tankful—approximately 3 hours under full load
- Dry weight—29 lbs

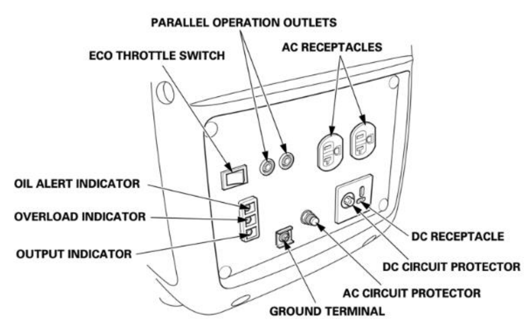
SPECIFICATIONS EU2000i

- Engine—GX100T
- Displacement: 6.01 cu in.
- AC output: 120-volt, 2000-watt maximum, 1600-watt rated
- Oil type and capacity: 10W-30 13oz
- Fuel tank capacity—.95 gallon
- Run time per tankful—approximately 4 hours under full load
- Dry weight—45 lbs

STORAGE AND FUELING

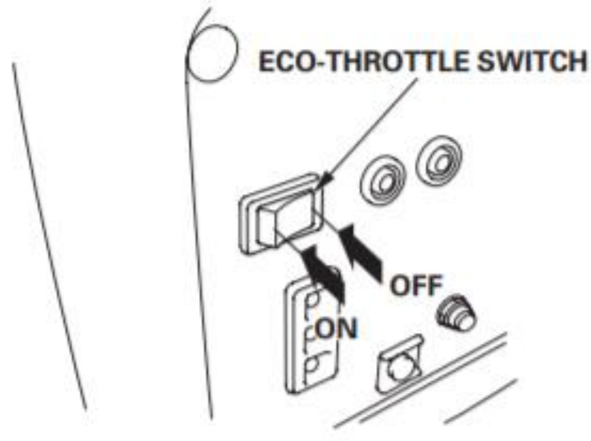
- To prevent fuel spillage, the generator should be stored upright in its normal operating position with the engine (on/off) switch and the fuel filler cap vent lever both turned off
- Use regular unleaded gasoline with an octane rating of 86 or higher, and no more than 10% ethanol or 5% methanol

INDICATOR LIGHTS



- The Output Indicator Light (Green) is illuminated when the generator is operating normally. It indicates that the generator is producing electrical power at the receptacles
- If the generator is overloaded, or if there is a short circuit in a connected appliance, the Overload Indicator Light (Red) will go on. After about four seconds, current to the connected appliance will shut off, and the Output Indicator Light (Green) will turn off
- The Oil Alert system is designed to prevent engine damage caused by an insufficient amount of oil in the crankcase. Before the oil level can fall below the safe limit, the Oil Alert indicator light comes on and the Oil Alert system will automatically stop the engine
- These indicator lights have a slightly different layout on the EU2000 than on the EU1000. However, the lights operate the same and mean the same thing on both models

ECO THROTTLE SWITCH



- When the Eco Throttle switch is on, engine speed is automatically lowered when loads are reduced, turned off, or disconnected. When appliances are turned on or reconnected, the engine returns to the proper speed to power the electrical load
- Turning the Eco Throttle on is recommended to minimize fuel consumption and reduce noise level when less than a full load is needed. Examples could include long-term events with low draw appliances, such as 500-watt quartz lights set up for a fire investigator to perform an investigation at a fire scene
- Engine should be run for a few minutes to warm up prior to turning on the Eco Throttle
- Having the Eco Throttle turned off means the generator will function like normal and idle at the designated setting when no load is attached. The Eco Throttle should be turned off for incidents such as working fires, where numerous appliances can be plugged in and the electrical load will frequently be changing

CONNECTING A LOAD TO THE GENERATOR

- Verify the engine is running
- Ensure the Output Indicator Light is on
- Make sure the appliance is in good working order
- Make sure the electrical rating of the appliance does not exceed that of the generator. Never exceed the maximum power rating of the generator. Power levels between the rated amount of the generator and the maximum amount of the generator may be used for no more than 30 minutes
- Plug in the appliance
- *Note: substantial overloading will switch off the AC circuit protector. Exceeding the time limit for maximum power operation or slightly overloading the generator may not switch the AC circuit protector off, but it will shorten the service life of the generator. If the AC circuit protector switches off automatically, check that the appliance is working properly and does not exceed the rated load capacity before resetting the AC circuit protector*

HONDA GENERATOR EB 5000X/EM 6500SX

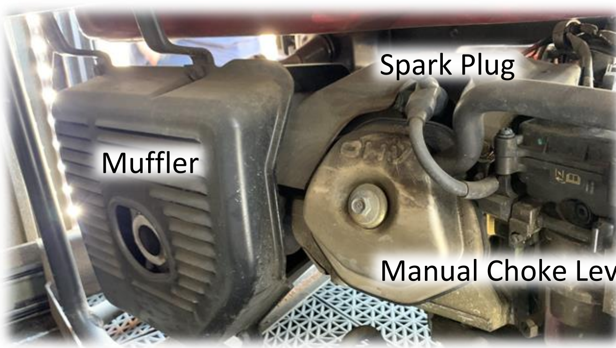
SPECIFICATIONS EB5000X

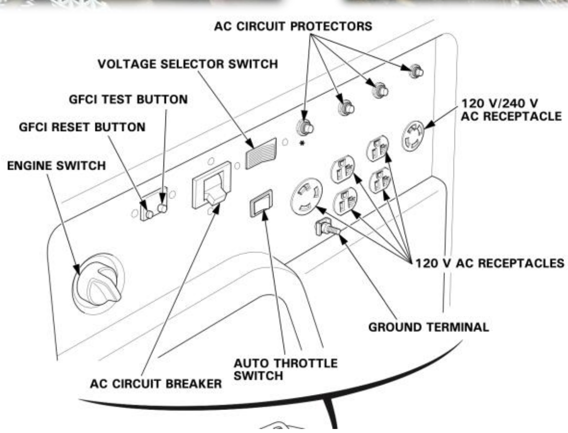
- Max power rating—5.0KVA for up to 30 minutes
- Continuous operation rating—4.5KVA
- Max output—7,000 watts for up to 10 seconds
- Weight—212.3 lbs
- Fuel Tank—6.21 gallons
- Run time at ½ Load—10.5 hours
- Run time at full load—7.1 hours

SPECIFICATIONS EM 6500SX

- Max power rating—6,500 VA for up to 30 minutes
- Continuous operation rating—5,500 VA
- Max output—7,000 watts for up to 10 seconds
- Weight—227 lbs
- Fuel tank—6.6 Gallons
- Run time at ½ load—9.8 hours

COMPONENTS





CONTROLS AND FEATURES

Engine Switch

Controls the ignition of the generator. Some models may only have an On and Off function (left). Others may have a Start function that will not require a firefighter to use the starter grip (right).

Starter Grip

Operates the recoil starter to crank the engine. All generators will have pull start capability, including those with a turn start option in case that fails to work.

Fuel Valve Lever

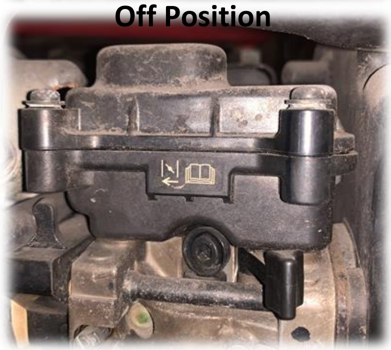
This controls the fuel supply from the fuel tank to the carburetor; it should be kept in the off position when the generator is not running.

Off Position

On Position

Auto Choke Control

This generator has an Engine Control Module that will automatically control the motor's throttle and choke when starting. The choke does not need to be operated when starting the motor. Use the choke only if the engine is hard to start using the normal starting procedures.



Normal Start Position

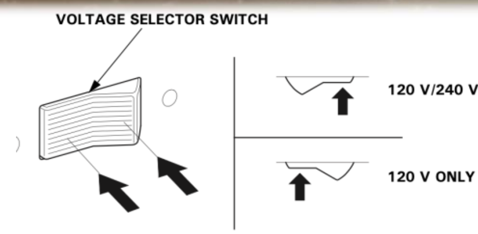
Hard Start Position

Voltage Selector Switch

(Photo on right) Changes the generator output to produce 120-volt only or 120/240-volt. If a 240-volt appliance is connected to the 4-prong receptacle, the switch must be in the 120v/240v position. The switch should also be in the 120v/240v position for back feeding the truck. If only a 120-volt appliance is connected to any of the 120-volt 3-prong receptacles, select the 120-volt only position. Select the voltage prior to starting the engine.

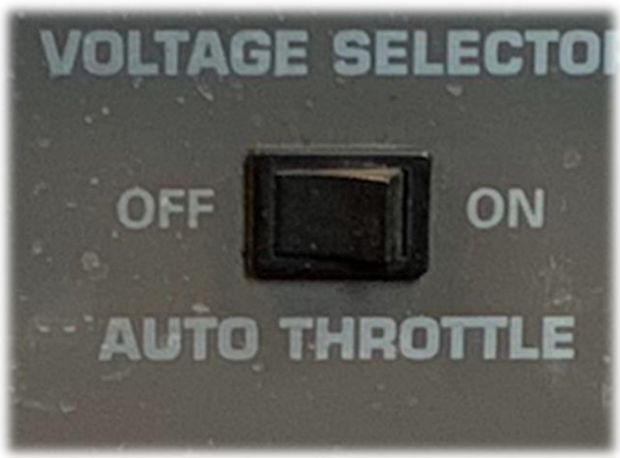
Auto Throttle System

(Photo on right) With the switch in the ON position, engine speed is automatically reduced when ALL loads are turned OFF or disconnected. When appliances are turned ON or reconnected, the engine returns to the rated speed. In the OFF position, the Auto Throttle system does not operate. The Auto Throttle System will not respond to electrical loads of less than 1 ampere or intermittent loads such as a staple gun.



AC Circuit Breaker

(Photo on left) AC circuit will automatically switch OFF if there is a short circuit, significant overload at the receptacles, or if the ground fault circuit interrupter (GFCI) detects a ground fault current. The AC Circuit Breaker can be used to switch the generator AC electrical power ON and OFF. Use the GFCI test button to ensure the breaker is working properly.



Intelligent Auto Voltage System iAVR

(Photo on the left) This is a built-in system that automatically regulates voltage. The iAVR can provide power in excess of the maximum rating for up to 10 seconds to start appliances that may require a higher initial startup current.

AUTOMATIC ENGINE STOP FUNCTION

The backup generators are equipped with several functions to protect the user and the generator itself. Below is a brief overview of some of these functions and how they operate.

Oil Alert System

During operation, the engine will automatically stop if there is not enough oil in the tank. If the generator is on a significant slope, the Alert System may also activate stopping the engine. The engine switch will remain in the ON position.

Overspeed Detection Function

Protects the engine from exceeding the engine load; the engine will stop if the speed becomes abnormal.

Abnormal Voltage Detection Function

Engine will automatically stop during generation when it detects abnormal voltage.

STARTING PROCEDURES

1) Turn off the AC Circuit Breaker
2) Turn the Fuel Valve Lever to the on position
3) Make sure the Auto Throttle is in the off position
4) Turn the Engine Switch to the on position
5) If using a pull starter grip, lightly pull until resistance is felt, then give a brisk pull. Firefighters can also use the turn start function if equipped on that generator
6) Turn the AC Circuit Breaker on to send power to the AC circuits
7) Auto Throttle may be turned on after 2-3 minutes of operation

STOPPING PROCEDURES

If it is an emergency situation, just turn the Engine Switch to off. However, the recommended procedure that should be followed in most circumstances is shown below:

1) Turn off and disconnect all the appliances connected to the generator
2) Move the AC Circuit Breaker to the off position
3) Turn the Engine Switch to the off position
4) Turn the Fuel Valve Lever to the off position

ADAPTERS, CORDS, AND LIGHTS

OVERVIEW

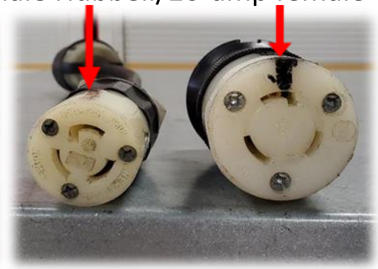
- Firefighters will find various plug adapters as part of the equipment complement on ladder trucks. As mentioned elsewhere, ladder companies were previously outfitted with 15-amp plugs. Although this is becoming more of a rarity as front-line trucks are being transitioned to 20-amp plugs, situations may still arise where adapters for these older plugs are needed (Older trucks will remain backups for years to come). For example, an adapter with a 20-amp female receptacle and a 15-amp male plug may be needed when using an older ladder truck that still has 15-amp plugs
- This section will illustrate some of the different electrical equipment the Division uses, and show some of their common variations
- All new ladder trucks are being ordered with 20-amp twist lock Hubbell connections

20-AMP TWIST LOCK HUBBELL CONNECTIONS AND ADAPTERS

- One of the more commonly used adapters is a 20-amp Hubbell female to a 3-prong straight blade male. This adapter allows firefighters to connect a Ram Fan to residential receptacles, rather than having to run a cord reel from the truck. The Division also has newer adapters that allow firefighters to connect the 20-amp Ram Fan plug into a Honda 2000 generator
- <u>*When switching over to reserve apparatus, firefighters must check the junction boxes attached to the cord reels to ensure they are the correct type*</u>
- Various adapters and types of connections are illustrated below

15-amp male/20-amp male Hubbell

15-amp female Hubbell/20-amp female



Ungrounded House

20-amp twist lock Hubbell

Grounded House

15-amp twist lock Hubbell

20-amp Hubbell female to 110v grounded house

20-amp Hubbell female to 3-prong straight blade

CORD REELS

- 200’ cord reel (below right photo) with 4-outlet junction boxes, common on most trucks. These junction boxes can be either 20-amp or 15-amp junction boxes. Be sure to check!
- 200’ single outlet cord reel (below left photo). These are not on every truck

CORD BAGS

- Common lengths include bags with 25’, 50’, or 100’
- Lengths can vary depending on the truck and the storage bag being used
- Many have 20-amp twist lock Hubbell connections

500-WATT TELE-LIGHTS

- The below left photo shows some different set ups that may be found in the Division
- Lights can be strung together (below right photo) using the plug on the base of the unit

BATTERY POWERED LIGHTS

- The 18-volt removable/rechargeable battery powered units have high and low modes
- Orange Streamlight lights are rechargeable using the in-truck mounts

Not waterproof Waterproof

POSITIVE PRESSURE RAMFANS

ELECTRIC RAMFAN EV400

- 1.5 horsepower
- Power—has a dual current toggle switch with two settings: 15-amp or 20-amp. The 20-amp setting is for powering the fan from a GFCI 20-amp fire truck circuit; the 15-amp setting is for powering the fan from a 15-amp house circuit or a 2-kilowatt generator (Honda EU 2,000)
- 115 volts
- Air output with the 15-amp setting: 9,184 cfm
- Air output with the 20-amp setting: 11,381 cfm
- Dimensions—22.6” H, 17.4” W, 18.5” D
- Weight—68 lbs

GAS RAMFAN GX200

- 2.1 horsepower
- Run time—1 hour and 40 minutes
- Impeller with 7 blades
- Noise—91 decibels
- Speed—3,450 rpm
- Air output—21,760 cfm
- Dimensions—21.5” H, 19.5” W, 20.5” D
- Weight—48 lbs
- Be aware that this fan produces CO

BATTERY RAMFAN EX50Li

- .8 horsepower
- Battery system specifications—40-volt lithium-ion, 432 watt-hour, 12 ampere-hour
- Should be plugged in when not in use
- 115 volts
- Run time:
    - DC—90 minutes (4 battery packs)
    - DC—45 minutes (2 battery packs)
    - DC—23 minutes (1 battery pack)
    - AC—unlimited run time
- Air output:
    - AC power—9,635 cfm
    - DC power—10,120 cfm
- Dimensions—22” H, 21” W, 12” D
- Weight—55 lbs

SMOKE EJECTORS

SUPERVAC P164SE (OLD RED BOX FAN)

- 1/3 horsepower
- Power: 115/230-volt AC, 50/60 hertz
- Cold crank wattage—2,000 watts
- Normal run wattage—700 watts
- Speed—1,725 rpm
- Output—5,200 cfm
- Dimensions—19.25” H, 18.75” W, 13” D
- Weight—49 lbs

RAMFAN EFC150X (NEW RED BOX FAN)

- 1.5 horsepower
- Power: 115/230-volt AC, 50/60 hertz
- Cold crank—80 amps
- Normal run—15 amps
- Speed—3,590 rpm
- Output—4,459 cfm
- Dimensions—19” H, 18” W, 16” D
- Weight—55 lbs

SUPERVAC HF164E (YELLOW BOX FAN)

- 1.5 horsepower
- Power: 115/230-volt AC, 50/60 hertz
- Cold crank wattage—6,000 watts
- Normal run wattage—2,100 watts
- Speed—3,450 rpm
- Output—9,620 cfm
- Dimensions—19.25” H, 18.75” W, 13” D
- Weight—63 lbs

CONSIDERATIONS

- For negative pressure ventilation, the tighter the seal that can be kept around the opening, the more effective the fan will be at drafting the internal contents of the structure out. All the above fans are intrinsically safe
- The yellow fan is designed as a confined space fan and can move a much larger amount of air. However, it is important to consider the watts required to do so. While a 2000-watt generator can run a fan for a short period of time, the on-board generator is a more suitable power source for the yellow box fan
- The door bar attachment tool, which is extendable from 26” to 60”, can be used to hang all types of fans at any height in a door or window

COLUMBUS ROPE BAG

OVERVIEW

- New rope bags were introduced to the Columbus Fire Department in 2019. The bags were designed by Columbus Firefighters for Columbus Fire. These bags were the direct result of many hours of training and hard work from many past and present CFD members. Below is a brief informational outline on the new Columbus Rope Bags

Click here to view Target Solutions video on the CFD Rope Bag

IDENTIFICATION AND SPECIFICATIONS

- Manufactured by Sterling Rope Co., Inc
- Classification: Escape Rope
- Search rope and personal escape rope
- Made of high strength, heat resistant nylon fiber
- Yellow Mainline Rope
    - 200' long
    - 8 mm diameter
    - Reflective, lightweight, durable, and fire-resistive
    - Minimum breaking strength—3,484 pounds
    - One end of the rope attaches to the inside of the mainline bag using a figure eight on a bight with an overhand safety to a locking carabiner. The locking carabiner is hooked to a webbing loop sewn to the inside of the bag. This carabiner is the only locking carabiner in the system
    - The other end of the rope is attached to a square non-locking carabiner using a figure eight on a bight with an overhand safety. This end also has the company ID Tag
    - Yellow rope deploys out of only one end of the yellow mainline bag

- Red Tagline Bags
    - 4 total 30' taglines—red rope
    - 8 mm diameter
    - Reflective, lightweight, durable, and fire-resistive
    - Minimum breaking strength—3,484 pounds
    - Each tagline bag has a bent neck non-locking carabiner that can be attached to the four D-ring attachment points on the mainline bag when stored, or they can be clipped to a firefighter when deployed
- Mainline and each tagline have non-locking carabiners for functionality
- Each bag has an ID Tag for easy accountability

RABBIT TOOL AND HYDRA-RAM II

HURST RABBIT TOOL SPECIFICATIONS

- 8,000 lbs of force
- Spreading distance—4”
- Weight—12 lbs
- Parts included:
  - Rabbit tool
  - 6’ hose
  - Manual pump
  - Pry bar
  - Mallet
  - Carrying bag with sling
- Tool should be checked under load
- To use the rabbit tool, turn the pump relief valve knob clockwise, then start pumping the handle up and down
- To relieve the pressure and retract the tool, turn the relief valve knob counterclockwise. The tool will retract automatically

HYDRA-RAM II SPECIFICATIONS

- 10,000 lbs of force
- Spreading distance—6”
- Weight—13 lbs for the tool itself, 14 lbs with the bag
- Length—15”
- The Hydra-Ram is the first patented one-piece integrated hydraulic forcible entry tool without hoses or auxiliary pumps. Parts included:
  - Tips—made of stainless steel with a tensile strength of 220,000 lbs
  - Hydraulic piston
  - Pump handle—138 lbs of pressure needed to create 10,000 lbs of lifting force
  - Quarter turn spring-loaded valve

- The tool should be checked while under load. Use full pump strokes only; short pump strokes can damage the piston
- Three stage hydraulic system:
  - 0-400 lbs—piston will move ¾” per pump
  - 400-1,200 lbs—piston will move ¼” per pump
  - Above 1,200 lbs—piston will move $^{1}/_{8}$” per pump
- To lubricate the Hydra-Ram, extend the piston fully, wipe clean with a rag, and apply 3-In-One Multipurpose Oil. Retract and extend the piston several times after lubricating to evenly distribute the oil

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SMALL ENGINE MAINTENANCE OVERVIEW

TRUCK OPERATIONS MANUAL

SECTION TOPICS

Small Engine Maintenance Overview	**Stihl Chainsaws—Changing a Chain**
Two-Stroke vs. Four-Stroke Engines	**Stihl Circular Saws**
How to Properly Mix Two-Stroke Fuel	**Stihl Circular Saws—Changing a Blade**
K-100 Fuel Additive	**Honda Generators**
Stihl Chainsaws	**Saw Operations—Reactive Forces**

SECTION OBJECTIVES

Understand the difference between two-stroke and four-stroke engines

Understand how to properly mix two-stroke fuel

Understand the uses for K-100 fuel additive

Identify, inspect, and maintain the various parts of a Stihl chainsaw

Understand how to change a chain on a Stihl chainsaw

Identify, inspect, and maintain the various parts of Stihl circular saws

Understand how to change a blade on a Stihl circular saw

Define and understand the reactive forces present during saw operations

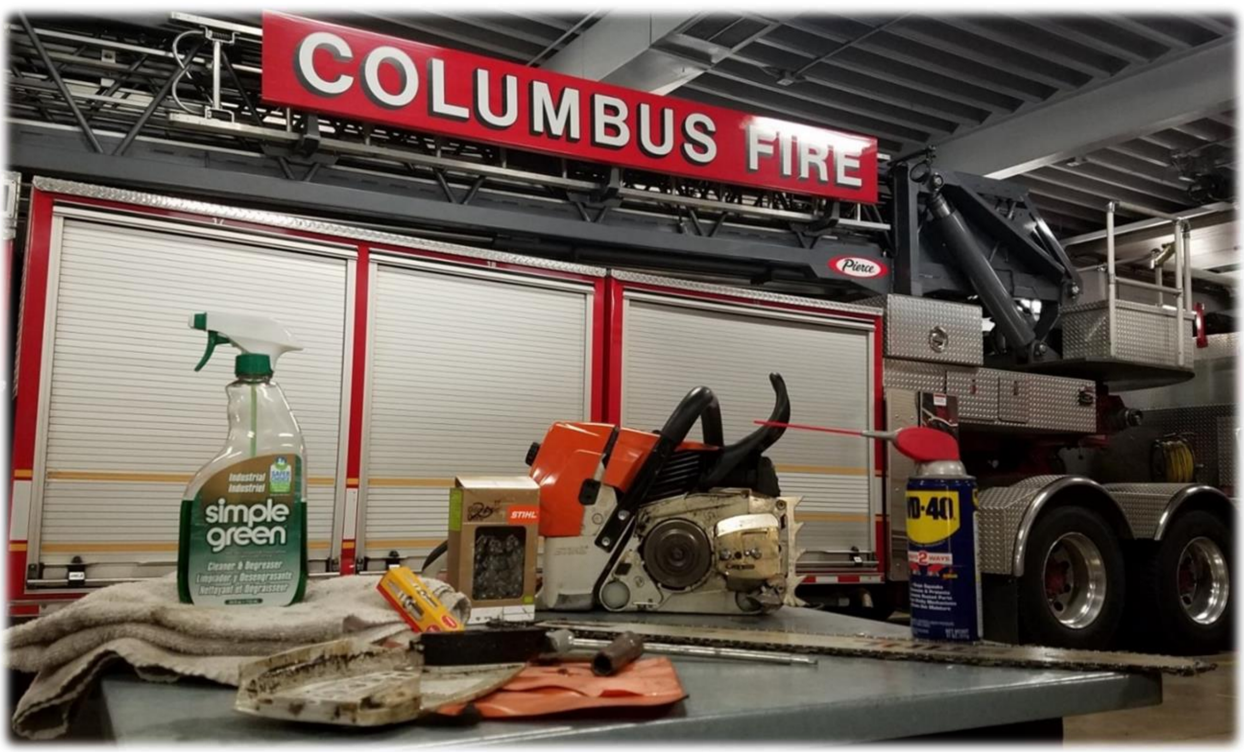
SMALL ENGINE MAINTENANCE

OVERVIEW

This section of the manual is designed to help apprentice firefighters understand the difference between two-stroke and four-stroke engines, as well as their associated care and maintenance. It is important to note that this section is not a comprehensive guide for small engine maintenance. It is simply an introduction to basic firehouse-level care that can help keep equipment running smoothly and help the apprentice firefighter become familiar with the different components of the equipment in the Division.

CONTENTS

- Two-Stroke vs. Four-Stroke Engines
- How to Properly Mix Two-Stroke Fuel
- K-100 Fuel Additive
- Stihl Chainsaws
    - Changing a Chain
- Stihl Circular Saws
    - Changing a Blade
- Honda Generators
- Saw Operations—Reactive Forces



TWO-STROKE VS. FOUR-STROKE ENGINES

OVERVIEW

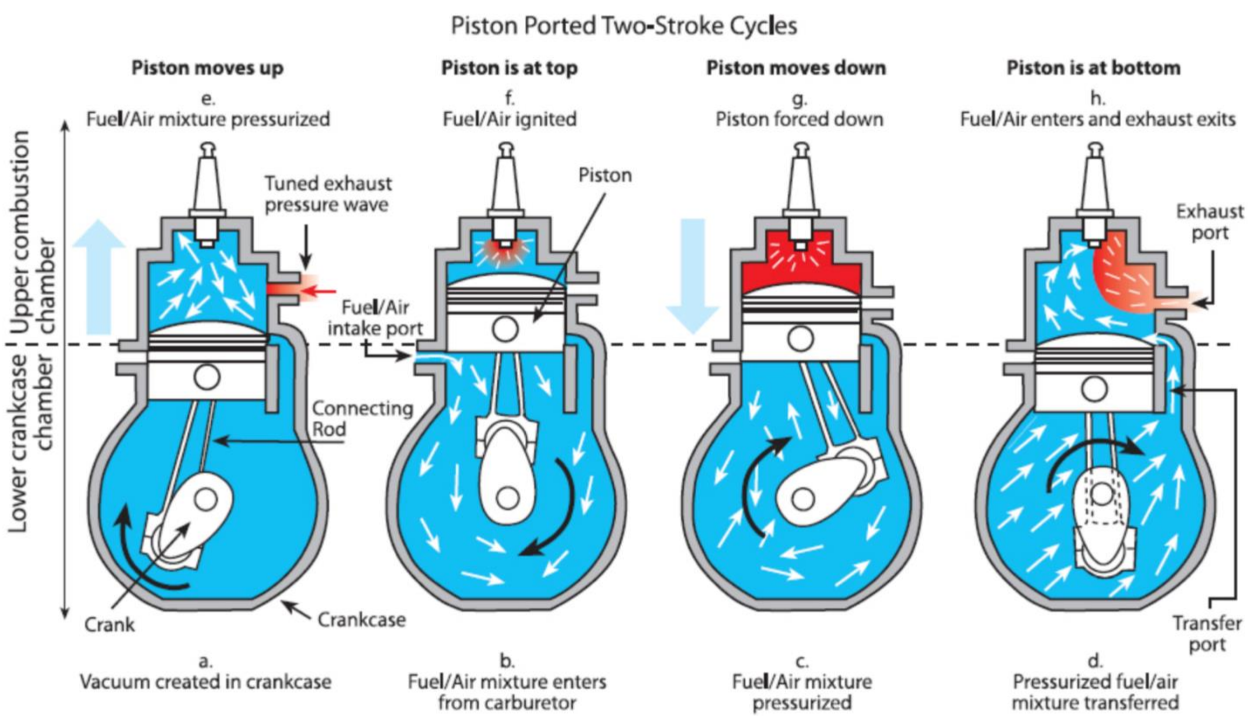
- Most engines are classified as either two-stroke (two-cycle) or four-stroke (four-cycle). However, what does that actually mean? Does it mean more than simply adding oil to the fuel or not? Both types of engines are in CFD's arsenal of equipment, and firefighters must be professional enough to know more than just which ones require oil in the fuel and which ones do not.

WHAT IS THE DIFFERENCE?

- A "stroke" refers to how many stages (piston/crankshaft movements) an internal combustion engine needs to complete to finish a "power (working) stroke"
- Two-stroke (two-cycle) engines require firefighters to mix the oil with the gas in exact amounts; the oil acts as a lubricant for the crankcase. However, four-stroke engines take oil and gas separately and have dedicated reservoirs for each
- In a two-stroke engine, the piston fires with every 360° rotation
- In a four-stroke engine, the piston fires with every 720° rotation

HOW DO 2-STROKE ENGINES WORK?

- A two-stroke engine combines the compression and exhaust steps on its upstroke while combining the intake and combustion on the downstroke. Because there are fewer moving parts in this engine, maintenance is easier and there is a high power-to-weight ratio. These engines produce torque at much higher rpms compared to their four-stroke (four-cycle) counterparts



This diagram is from Chapter 4 of Powered Parachutes Flying Handbook figure 4-3

TWO-STROKE SUMMARY

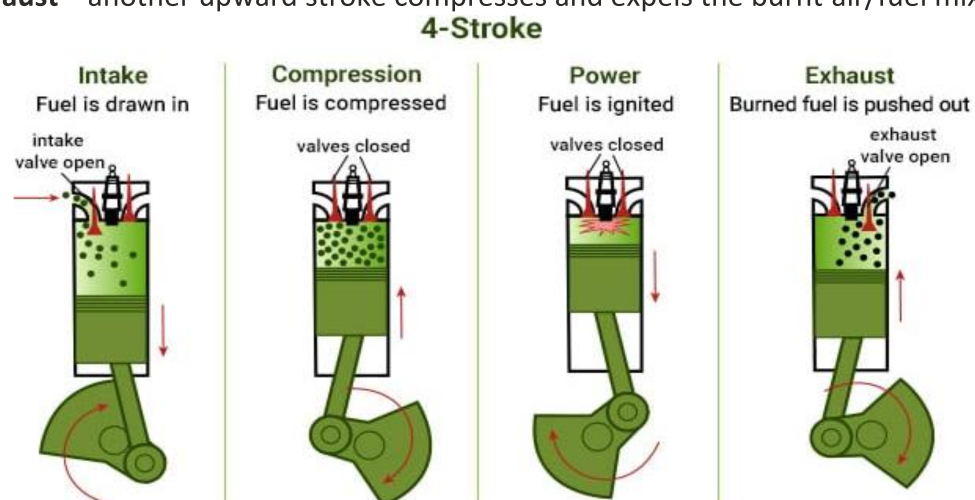
1. **Compression/Exhaust—**as the piston travels up, a negative pressure is created in the crankcase. This draws the fuel/oil mixture into the crankcase for lubrication, and pushes the burnt fuel-oil mixture out of the combustion cylinder. The unburned fuel/oil mixture is then compressed into the combustion chamber in preparation for the power stroke
2. **Intake/Combustion—**after the spark plug ignites, the fuel/oil mixture burns, creating the power stroke forcing the piston down and creating positive pressure in the crankcase

HOW DO FOUR-STROKE ENGINES WORK?

- Four-stroke engines have a separate reservoir for oil; there is no need to mix oil with the fuel. They have an internal oiling system to ensure proper lubrication. These engines are more fuel-efficient than two-stroke engines and provide more torque at a lower rpm. However, their weight-to-power ratio is much worse compared to a two-stroke engine

FOUR-STROKE SUMMARY

1. **Intake—**a downward stroke draws in fuel
2. **Compression—**an upward stroke compresses the air/fuel mixture
3. **Combustion (Power)—**compressed air/fuel mixture is ignited, generating downward force of the piston/crankshaft
4. **Exhaust—**another upward stroke compresses and expels the burnt air/fuel mixture



This diagram retrieved from PowerEquipmentDirect.com

PROS AND CONS OF EACH ENGINE

Two-Stroke	Four-Stroke
Pros	**Pros**
Simple Mechanics and Construction	Fuel Efficient
More Powerful	Less Pollution, Cleaner Burning
Not Positional	More Low-End Torque
	Greater Longevity
Cons	**Cons**
Less Fuel Efficiency	Complicated Mechanics
Limited Longevity	Expensive
Low End Torque	Less Powerful

HOW TO PROPERLY MIX TWO-STROKE FUEL

OVERVIEW

As discussed earlier, two-stroke/cycle engines do not have their own dedicated oiling systems (such as an oil reservoir, pump, etc.) to rely on for proper lubrication. Thus, firefighters must be proficient at properly mixing fuel to the proper ratio; this ensures the small two-cycle engines are protected and receive the correct lubrication needed to keep them performing efficiently. There is a slew of mix ratios for two-cycle small engines ranging from 25:1, 32:1, 40:1, and 50:1. The most common mix ratio is 50:1, and that is the mix ratio utilized within CFD for the Division's saws. A 50:1 ratio means the following—50 parts of fuel is mixed with 1 part of oil. Therefore, firefighters are adding 50 times as much gas as they are adding oil.

MIXING FUEL

Within CFD, the Stihl High Performance two-cycle engine oil (orange bottle) is utilized. This is a conventional oil, unlike the Stihl Ultra High Performance two-cycle engine oil (silver bottle), which is a synthetic oil. The Ultra High Performance (silver bottle) is used in the Division occasionally, but it is not found in the same volume in which the orange bottles are found. These silver bottles are typically smaller and come in either the 2.6 fl. oz. size (which makes one gallon) or the 5.2 fl. oz. size (which makes two gallons) of mixed gas. A fool-proof way to determine the amount of oil needed is to take the 2.6 fl. oz. and multiply it by the number of gallons of gas that firefighters plan on mixing.

A good habit is to ensure the gas container is empty prior to mixing. Add the oil in first; then fill the container with gas to ensure proper and complete mixing. Ideally, firefighters should be using premium high-octane fuel (Stihl recommends a minimum octane rating of 89 with no more than 10% ethanol; however, 90 or above is CFD's preferred recommendation).

EXAMPLE

If making five gallons of mixed gas, use this formula: 2.6 fl. oz x 5 = 13 fl. oz. of oil in five gallons of gasoline to create a 50:1 mix ratio.

K-100 FUEL ADDITIVE

OVERVIEW

K-100 is an all-in-one fuel treatment and stabilizer that should be added to both two-cycle mixed gas and straight gas in an effort to ensure the Division's fleet of small engines are better maintained and cared for.

K-100 USES

- Cleans injectors and carburetor jets
- Eliminates or reduces water in fuel
- Stabilizes fuel for up to two years
- Improves power and efficiency
- Lubricates the complete fuel system
- Reduces emissions

TO PROPERLY USE

Mix ½ ounce of K-100 per one gallon of gas. For longer term storage, utilize a mix ratio of one ounce of K-100 per one gallon of gas. Also reference **Division Bulletin #15-015**, which provides further information on K-100 and its uses/mix ratio.

STIHL CHAINSAWS

OVERVIEW

- This section is designed to build on the chainsaw pages in the Equipment section
- Breaking down and inspecting each individual part of the chainsaw will be covered in this section, in addition to some commonly accepted practices for station level maintenance
- The last part of this section will cover how to change the chain on <u>most</u> Stihl chainsaws
- **<u>Firefighters operating a chainsaw must always wear proper eye protection</u>**

[Click here to view a video on Chain Saw Components]

SPROCKET COVER

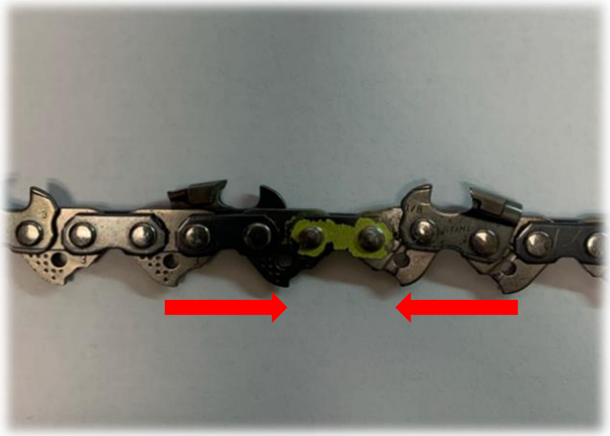
Disengage the chain break and remove the screws and the cover. Use a rag to remove any dirt, debris, and sawdust from the unit. Wipe down the unit with Simple Green, then dry it.

GUIDE BAR

Release the tension screw and remove the guide bar and chain. Inspect the bar for any obvious signs of wear and tear. Any spurs can be filed down gently with a bastard file. The photo on the left shows an example of mushrooming. Any dirt and debris in between the guide bar can be carefully pulled away from the sprocket out the end of the bar using any flat head screwdriver. Wipe any dirt and debris with a rag. Simple Green can be used for any remaining stuck on grime, if necessary. Once the bar is clean, lightly cover the bar in WD40 and wipe the excess off. (Excess oil can attract dirt). After each use, flip the guide bar over to avoid uneven wear and tear, especially on the sprocket nose.

CHAIN

Inspect the chain for obvious signs of wear and tear. No more than 3 teeth in a row or 5 total can be missing. (72 links and 36 teeth total). If needed, replace the chain with a new one and keep the old chain for training. Inspect the chain to ensure all teeth are traveling in the same direction. These chains are cut from large spools at Tools and Equipment, and there have been instances where chains were put together incorrectly (photo on right).



MAIN UNIT

With the guide bar, sprocket cover, and chain still off, wipe down any additional dirt and debris from the main unit of the saw. Simple Green may be used for any tough grime. If using a water hose to spray off the saw, avoid getting the air filter wet.

Inspect the oil inlet hole, oil outlet channel, and bar groove to ensure they are free of dirt and debris. If obstructions are found in the oil outlet channel, be sure to pull them out and away from the channel. Do not push or blow dirt back down into the unit. Use this time to check the oil quantity control setting on the bottom of the saw. (E = moderate oil delivery) CFD runs with the setting all the way open.

Ensure both the fuel filler cap and the oil filler cap are free of dirt. Remove both and inspect the guides that lock in the caps for dirt. Wipe with a rag if needed. Do not forget to clean the bottom ground guard of the unit.

AIR FILTER

Before removing the carburetor box cover, make sure the saw is in the FULL choke position to ensure no dirt falls down into the carburetor.

Once the box cover is removed, ensure the temperature slide is located in the correct position (Winter mode when 50° or below).

Remove the air filter and knock the filter out by tapping it on the ground, or blow it clear with compressed air from the inside outward. (This should be sufficient 99% of the time). If not, filters may be cleaned using water and Dawn. This method is not preferred because the filter must be cleaned using low pressures and be given ample time to dry before being reinstalled.

Visually inspect the carburetor for major dirt and debris and remove any debris, if necessary. Always pull debris out and away from the carburetor; never push it in.

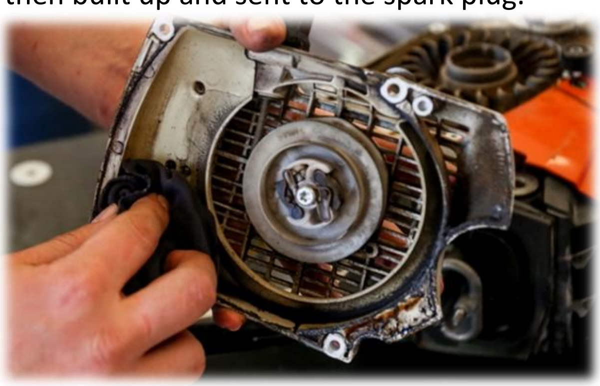
SPARK PLUG

To change/check the spark plug, first remove the air baffle and unplug the spark plug boot. Next, use the tool to unscrew the spark plug. If needed, clean the spark plug using a wire brush or just replace the spark plug. Check the manufacturer spark plug gap measurement using a gap tool (.5mm). Finally, re-tighten the spark plug firmly with the tool and replace the boot and air baffle.

FAN HOUSING

Before removing the fan housing, slowly pull out the starter pull cord and visually inspect it for any obvious signs of damage. Use compressed air to blow dirt from the inside of the housing out. Wipe down the cover with a rag and Simple Green if needed. Avoid chemical direct contact with the pull cord.

The red circle highlights the saw's magneto. This is where the electrical charge is generated to fire the spark plug. As the flywheel spins, a magnet passes over the magneto; an electrical charge is then built up and sent to the spark plug.



RETURN TO SERVICE

Replace all components once each one has been properly cleaned, lubricated, and dried. Properly tension the chain as shown in the next section. The chain should be able to be slid along the bar by hand. With the saw on the ground, lift up on the chain only; when doing so the drive link tangs should not be fully exposed. Ensure the fuel and bar oil are filled. Once all components are back together, ALWAYS start it and go through a quick Monday check on the equipment to ensure it was put back together properly.

[Click here to view a video on Cleaning STIHL Chainsaws]

STIHL CHAINSAWS—CHANGING A CHAIN

1. Using a saw wrench, loosen the bar stud nuts and remove the chain sprocket cover

2. Next, turn the chain tensioning screw counterclockwise to loosen the chain

3. Disengage the chain brake

4. Remove the guide bar and chain from the drive sprocket. Inspect the oil inlet on the saw body and the oil passageway on the guide bar for cleanliness and possible obstructions

5. Discard the old chain or save it for training, depending on its condition

6. Inspect the guide bar for uneven wear, mushrooming, or other damage. If needed, file using a single cut mill bastard file. The photo on the left shows slight mushrooming on the guide bar.

7. Prior to re-installation, flip the guide bar to promote even wear

8. Fit the new chain on the guide bar, starting at the nose or end of the guide bar

9. Fit the guide bar over the bar studs. The cutting edges on the chain on the top of the guide bar must point forward. (**Rakers** aka **shark fins** swimming away from you). The photo on the left highlights the direction of travel for the rakers

10. Engage the tensioner slide in the locating hole on the guide bar and place the chain over the drive sprocket at the same time. Firefighters might have to further loosen or take up slack with the chain tensioner to get the proper fit

11. Turn the tensioning screw clockwise, taking up slack with the chain saw chain and the drive tangs fully engaged in the guide bar

12. Refit the sprocket cover and screw on the bar stud nuts finger-tight. Ensure that the bar does not drop or lower in position while this is being done

13. Utilizing the weight of the saw as a reference, pick up on the chain saw chain mid-length on the guide bar until the front body of the saw shows a slight sign of lift. With the saw body slightly lifted, the chain is properly tensioned if the bottom part of the drive tang is still engaged in the guide bar groove. The photos on the left show a loose chain vs. a correctly tightened chain

14. Confirm proper chain tension and repeat if necessary. Be sure to account for additional tensioning once the bar stud nuts are completely tightened

15. Fully secure the bar stud nuts

16. Check the chain tension again for proper tensioning following the tightening of the bar stud nuts. With the chain brake disengaged, ensure the chain travels freely and properly by pulling on the chain with a gloved hand. If unable to pull the chain by hand with the brake off, it is too tight. Remember that after running a new chain you may need to check the chain tension again because it will expand when heated

17. Reengage the chain brake
18. Properly start the saw and ensure proper operation and oiling of the bar
19. At this time, allow the saw to warm up to operating temperature (roughly 2-5 minutes)
20. Top the saw off with 50:1 mixed fuel and with bar oil before placing the saw back in service

[Click here to view a video on Changing a STIHL Chainsaw Chain]

STIHL CIRCULAR SAWS

OVERVIEW

- This section is designed to build on the circular saw pages in the Equipment section
- Breaking down and inspecting each part of the circular saws will be covered in this section, in addition to some commonly accepted practices for station level maintenance
- The last part of this section will cover how to change the blade on <u>most</u> Stihl circular saws
- **<u>Firefighters operating a circular saw must always wear proper eye protection</u>**

[Click here to view a video on STIHL Circular Saw Components]

BLADE

Ensure that blades being replaced are the correct type, arbor size (20 mm), and spindle speed (5,350 RPM or higher). Inspect DAX blades for fissures, undercutting, and missing teeth. Inspect composite blades for frayed edges, chemical stains, and uneven wear.

To remove the blade, insert the slide locking pin through the hole in the V-Belt guard. Use the wrench to remove the front thrust washer bolt and remove the washer. Note: ensure the locking pin is properly seated straight into the hole (bottom left photo), NOT on an angle (bottom right photo). Reinstall the blade by reversing these steps. Ensure that the blade does not wobble and that the washer sits flush against the blade.

BELT

Inspect the V-Belt for obvious wear and tear by removing the arm guard cover and visually inspecting the drive belt.

MAIN UNIT

Wipe down any dirt and debris from the main unit of the saw. Simple Green may be used for any tough grime. Avoid using a water hose to just spray off the body of the saw; an air hose would be preferred. Ensure the fuel filler cap is free from dirt. Remove and inspect the guides that lock in the cap for dirt; wipe with a rag if needed. Do not forget to clean the bottom ground guard of the unit.

AIR FILTER

Before removing the air filter cover, make sure the saw is in the FULL choke position to ensure no dirt falls into the carburetor. Unless cutting concrete or other masonry materials, the air filters will only need to be changed approximately once per year or as otherwise noted per the manufacturer. Once the cover is removed, wipe off any dirt and debris with a rag and Simple Green. Remove the auxiliary and primary air filters and knock the filters out by tapping them on the ground, or blow them clear with compressed air from the inside outward. (This should be sufficient 99% of the time). If not, filters may be cleaned using water and Dawn. This method is not preferred because the filters must be cleaned using low pressures and be given ample time to dry before being reinstalled. Both the auxiliary and primary air filters should be checked for damage. If damaged, both should be replaced together.

PULL CORD

Engage the decompression valve and slowly pull out the pull cord to visually inspect it for any dirt, debris, or fraying of the cord.

SPARK PLUG

To change/check the spark plug, remove the spark plug cover, unplug the spark plug boot, and use the tool to unscrew the spark plug. If needed, clean the spark plug using a wire brush or just replace the spark plug. Check the manufacturer spark plug gap measurement using a gap tool. Re-tighten the spark plug firmly and replace the boot and air baffle.

RETURN TO SERVICE

Reinstall the filters and the air filter cover. Ensure the saw is fueled using 50:1 gas/oil mixture. Check to make sure the blade is tightened before starting the saw. Once all components are back together, ALWAYS start the saw and go through a quick Monday check on the equipment to ensure it was put back together properly.

STIHL CIRCULAR SAWS—CHANGING A BLADE

1. Slide the locking pin through the bore in the V-belt arm

2. Turn the circular saw blade by hand until the locking pin engages in the bore behind the guard

3. Confirm that the locking pin limits or restricts the rotational turn of the saw blade. Ensure the locking pin is properly seated straight into the bore, not on an angle like the photo on the right

4. Use a saw wrench to loosen and remove the arbor bolt

5. Completely remove the front thrust washer from the spindle

6. Remove the circular saw blade and discard it, or save it for training use

7. Prior to installation, inspect the new circular saw blade to ensure it is the proper size for the saw (12” or 14” blade size). Make sure the blade is rated for at least 5,350 rpm, which is the max spindle speed of CFD Stihl circular saws. Make sure the type of blade is appropriate for the size of the saw (For instance, a TS500 should not run a DAX blade). Also, confirm whether the blade has a 20 mm arbor or a larger 25 mm arbor. The 25 mm arbor requires the use of a spacer placed over the spindle before installing the new blade

8. Fit the new circular saw blade onto the spindle (note the arrows indicating the direction of the rotation if applicable)

9. Place the front thrust washer back onto the spindle. Ensure that the tangs of the front thrust washer engage the grooves located on the spindle

10. Screw in the arbor bolt and tighten it with the saw wrench

11. Remove the locking pin from the V-belt guard

12. Spin the circular saw blade by hand to confirm proper fit and to ensure the blade does not wobble

13. Start the saw and ensure proper operation

14. At this time, allow the saw to warm up to operating temperature (roughly 2-5 minutes)

15. Top off with 50:1 mixed fuel and place the saw back in service

[Click here to view a video on Changing STIHL Circular Saw Blades]

HONDA GENERATORS

OVERVIEW

- This section is designed to build on the Honda Generator pages in the Equipment section
- Breaking down and inspecting each individual part of the Honda generators will be covered in this section, in addition to some commonly accepted practices for station level maintenance

MAIN UNIT

Using a rag and Simple Green, wipe down the unit to clean any dirt and debris present. Ensure the control panel is free of any damage. Check to ensure the Eco Throttle is turned off. Check for any damage to the appliance and the appliance cord, if applicable.

FUEL

Inspect the fuel filler cap and threads to ensure they are free of any dirt and debris. Store the unit upright in its normal operating position with the engine (on/off) switch and the fuel filler cap vent lever both turned off to prevent fuel spills. Ensure the unit is filled with gasoline of at least 86% octane and no more than 10% ethanol.

OIL

Remove the left side maintenance cover and locate the oil filler cap. Check the oil level; oil should reach the lip of the oil filler neck. If oil is below the limit, additional oil can be added directly into the oil filler neck (SAE 10W-30 oil preferred). When referring to oil, 30 references the viscosity at 100°. The W references the viscosity of oil at low temperatures. To change the oil, place a drip pan underneath the oil filler neck and drain the oil. Next, add the new oil as described above. A good practice is to place a piece of duct tape on the inside of the maintenance cover and document on it when the oil was changed and when it should be changed again. The manufacturer recommends changing the oil every 6 months or 100 hrs.

AIR FILTER

Remove the left side maintenance cover and locate the air cleaner cover. Remove the foam air filter and inspect it to see if it is dirty. If it is dirty, clean the filter using warm soapy water, rinse it, and allow it to dry fully. Once cleaned, take the dry air filter and dip it in clean engine oil. Squeeze the excess oil out (do not twist the filter) and place the filter back into place. The easiest way to do this at the station is to add some oil into a large zip lock bag, place the filter in the bag, and squeeze it out before reinstalling. Once the filter has been reinstalled, use a moist rag to wipe down the rubber air guide and any other debris inside the filter area. Reinstall and tighten the left side maintenance cover. *Note: when the engine is started up, it will smoke when burning off any excess oil.*

SPARK PLUG

To change/check the spark plug, remove the spark plug cover, unplug the spark plug boot, and use the tool to unscrew the spark plug. If needed, clean the spark plug using a wire brush or just replace the spark plug. Check the manufacturer spark plug gap measurement using a gap tool (.6-.7mm). Retighten the spark plug firmly and replace the boot and the air baffle.

MUFFLER

Remove the muffler protector and clean the inside of the housing cover using Simple Green and a rag. Additional muffler service to the spark arrester should typically be handled by Tools and Equipment. If needed, the muffler and spark arrester unit can be removed and cleaned with a wire brush. Removing the cover to clean should rarely need to be completed.

SAW OPERATIONS—REACTIVE FORCES

OVERVIEW

- This section outlines some of the common reaction forces encountered when operating a saw
- Watching the attached Target Solutions videos starring Retired Captain Greg Lash is highly recommended

Click here to view Captain Lash's video on Saw Reaction Forces

Click here to view Captain Lash's video on Cutting with Finesse

SPRING POLE

- Definition—tree limb under tension which releases said tension after being cut. (**CAUTION—**this has the potential to seriously injure or kill the operator and those in close vicinity)
  - Can be encountered on auto accidents or downed trees
  - Can be countered by making relieving cuts along the length of the affected limb
- Felling
  - Requires experience
  - Dangerous operation which should be avoided unless absolutely necessary

KICKBACK

- Most critical reactive force created by the chainsaw
- Occurs as a result of the top ¼ of the tip of the chain/bar (known as the kickback zone) hitting another log, knot, car, pipe, or other foreign object and rapidly pivoting the saw right back onto the operator
- Just by informing professional loggers in the 1980s about the dangers associated with kickback, injuries decreased by 50%

KICKBACK CONT.

- Safeguards against kickback include the following:
  - Proper body positioning/stance
    - Front arm straight (body mechanics will keep the saw from coming back onto the operator)
    - Back leg out of the cut path of the saw
  - Hand positioning
    - Thumb fully encircling the front handle
    - Hand topside on the front handle in position to engage the chain brake if kickback occurs

PULL IN

- Occurs when the chain grabs hold of the cutting material and pulls the operator toward the saw
- Has an amplified reactive force when the saw is not operated at full speed
- Can occur when the operator is stretching out from the end of an aerial or ground ladder and can result in the operator being pulled off the ladder

PUSH BACK

- Another very quick reactive force
- Occurs when undercutting and the top of the bar stops or is pinched, forcing the saw to be shot back forcefully at the operator
- Can also occur when cutting normally
- Ideally, all cuts should be made using the following methods:
  - With the bar starting at a right angle to the cutting material
  - At full RPMs
  - The operator using feel and sound to know when the saw is performing inadequately, or when the chain is underperforming
    - Chain is becoming dull when the thrown chip size is small and the cutting speed is reduced

PLUNGE/BORE CUTTING

- This cut type involves using the tip of the saw to start the cut
  - Used on roof ventilation
  - Increases the risk of kickback exponentially
- Ways to prevent kickback include the following:
  - Operate the saw at full throttle
  - Start the plunge/bore cut with the bottom of the chain/guide bar at a lower angle, then steepen the angle of the saw
- Kerf cut—a cut the width of the bar
- Firefighters should consider adding a felling wedge to their coat pockets or to the saw tool box to assist with removing a saw when the bar gets pinched

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LADDER COMPANY APPARATUS OVERVIEW

TRUCK OPERATIONS MANUAL

SECTION TOPICS

Columbus Truck Reference Page

Platforms

Tillers

Short-Jacking

Emergency Power Unit (EPU)

Scene Lighting and Generators

SECTION OBJECTIVES

Identify positive and negative characteristics of platforms

Identify specifications of the Sutphen SP 95 platforms

Identify specifications of the Sutphen SPH platforms

Identify positive and negative characteristics of tillers

Understand how to operate a Pierce tiller

Understand how to operate an American LaFrance tiller

Understand the process for short-jacking all types of ladder trucks

Understand the process for using the EPU on all types of ladder trucks

Understand how to operate an on-board generator

Understand the process for switching to a back-up generator to power the truck

Understand the lighting options available, both truck-mounted and portable

COLUMBUS TRUCK REFERENCE PAGE

STATION	MODEL	YEAR	BRASS TAG
1	ALF 110’	2008	23051
2	SPH 100’	2020	29077
5	Pierce 105’	2018	27529
8	Pierce 107’	2019	28205
10	SPH 100’	2013	25875
12	Pierce 105’	2012	25139
13	Pierce 105’	2012	25138
15	Pierce 105’	2012	25137
22	SPH 100’	2016	26901
23	SPH 100’	2014	26334
24	Pierce 105’	2016	26838
26	SPH 100’	2019	28299
27	ALF 110’	2008	23053
28	Pierce 107’	2019	28284
32	SPH 100’	2011	24376
33	SPH 100’	2017	27329
XL-2	SPH 100’	2011	24378
XL-3	SPH 100’	2005	17352
XL-5	ALF 110’	2002	17238
XL-8	ALF 110’	2008	23052
XL-15	ALF 110’	2001	17234
XL-22	SPH 100’	2005	17351
XL-26	SPH 100’	2011	24377
XL-28	ALF 110’	2008	23054
XL-45	ALF 110’	2001	17232
XL-46	SP 95’	2001	17236

PLATFORMS

OVERVIEW

As of 2021, Columbus Fire currently has 12 platform ladders in its fleet with 7 of these platforms serving as front-line apparatus. All the platforms in the fleet are mid-mount platforms built by Sutphen. The aerials on these trucks are constructed of aluminum (#6061-T6). It is a four side, box-boom design constructed using Huck Bolt technology. All the front-line platforms are SPH models with 100’ of vertical reach.

Huck Bolts are precision engineered two-piece fasteners that never come loose once installed. No matter how vibration-intensive the environment, Huck Bolts stay put without requiring torquing.

The older model platforms are the SP model with 93’ of vertical reach. The SP models are easily identifiable by the lower hanging bucket and the ground ladders stored on the flat surfaces on the outside of the truck. Both models of CFD platforms are very similar to operate, other than a few minor changes. At the time of this manual’s publication, the CFD fleet has one remaining SP ladder.

Click here to view a video on how to set up a platform ladder

The following section will illustrate some of the positives and negatives of the Platform aerial and give a general overview of the differences between the SP model and the SPH model of platforms. This section will conclude with general considerations firefighters should review about operating a Platform.

POSITIVES ABOUT PLATFORMS

- Have their own centrifugal pump; does not require an engine to flow water
- Shorter length than tillers, made with lighter aluminum (corrosion resistant ladder)
- Firefighters are able to ride in the bucket to the destination with equipment versus having to climb an aerial while carrying their equipment
- Designed to allow operation from the bucket by one firefighter
- Sutphen platforms have two nozzles instead of the one nozzle on tillers
- The flow of water can be started and stopped by firefighters in the bucket. Hand wheel control valves are located inside the bucket with the operator
- Has a gate-valve installed at the end of the waterway to make elevated standpipe operations easier for firefighters. The operator in the bucket can dial in the correct pressure if an in-line pressure gauge is used
- Tip load does not change with the angle or extension of the ladder. The four-sided boom design of the aerial provides increased strength and durability to the aerial

NEGATIVES ABOUT PLATFORMS

- Bucket has a wider profile than the tiller tip, which makes it more difficult to fit through trees or other obstacles
- Higher profile makes it harder to get under wires than a tiller
- Larger turning radius requires a significant amount of space to make turns
- Aerial is not designed for climbing; the high hand rails are added per CFD orders to allow safer climbing
- Wider jack spread than the tillers
- Tougher to walk up the ladder with tools at low angles



The above photos show a pike pole attached to the rear bumper of an SPH platform. The pike pole dragging in the snow draws an outline of how far out the rear of the platform will swing when taking a sharp right turn. The bumper swung about 4 ½ feet past the tire tracks; the bucket would still extend above this another couple feet past the bumper. When making turns, the driver must be extremely aware at all times where the bucket positioning is in relation to the truck.

SUTPHEN SP-95 PLATFORM

OVERVIEW

The SP-95 platform models are the oldest platform ladders in CFD’s fleet. There are no longer any SP-95 models assigned as front-line vehicles. The SP-95 models are easily differentiated from the SPH-100 models by identifying the lower hanging bucket and the ground ladders stored on the flat surface on the outside of the truck. The SP-95 model has the least amount of compartment space compared to the other models of ladder trucks (Tillers and Platforms) in the Division. As a result of this reduced compartment space, companies performing a changeover into a SP-95 will likely have to leave some of their normal equipment at the station. Driver/operators of the SP-95 must pay very close attention when driving these trucks; the bucket has a significantly larger swing area compared to the SPH-100.

SPECIFICATIONS

- Oldest Platforms in the fleet
- Least amount of compartment space compared to any current CFD Ladder truck
- 93’ reach with the aerial
- Aerial has a 1,000-LB tip load when dry; 500-LB tip load when the waterway is charged
- Setting up the truck for aerial use follows the same steps as the SPH-100
- Has an older interlock system that requires two firefighters to be present when short-jacking the truck
- Total length of one extended outrigger is 5’ 3”
- Total distance of jack spread from jack-to-jack is 18’
- Shorter jack spread compared to the SPH models

The buckets stick out significantly more and hang lower than the current SPH models. This creates a larger bucket swing, meaning drivers need to be more aware of the bucket position while turning

These ladders had 4-section aerials, which caused them to have more stability than our newer SPH ladders

Ground ladders are stored outside the truck on the flat surfaces. Longer ground ladders are stored under the aerial and will require the aerial to be raised to gain access to those ladders

The bucket is accessed via a small folding step ladder on the rear of the bucket, unlike the side access used in current SPH models. This style of bucket can make taller parapets harder to navigate; the use of a roof ladder may be required

SUTPHEN SPH PLATFORM

OVERVIEW

CFD received its first two SPH model platforms in 2005. At the time, these models had more changes than the Division had seen in the last several generations of platforms, requiring crews to adapt to the changes. Some of these changes included the following:

- Changed to push button controls for the outriggers instead of the traditional hydraulic levers
- The push button outrigger controls are shown in the top right photo
- The lever style outrigger controls are shown in the bottom right photo
- The most recent models of the SPH platforms have switched back to being ordered with the lever style outrigger controls
- A shorter wheelbase gave the truck a significantly reduced turning radius
- Wider jack spread—the total jack spread increased to 22’ from 18’ on the previous model
- Bucket access—changed to steps on the driver’s side near the bucket instead of the fold down step on the bucket

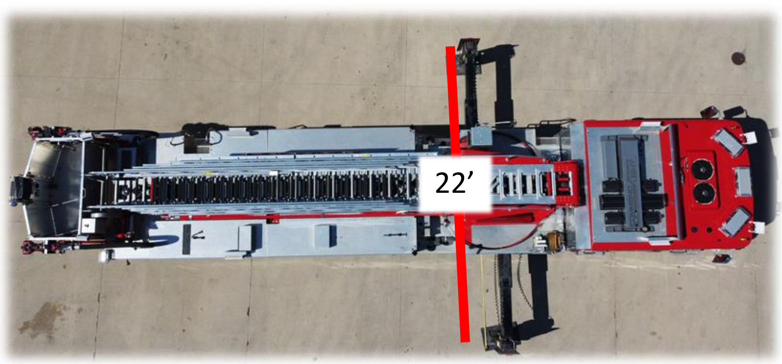
One additional change is that the construction of the ladder transitioned from a 4-section ladder to a 5-section ladder. These 5-section ladders have more sway when the aerial is in use

A majority of the changes listed on the previous page can still be found on the current SPH models in use today. Listed below are some notes about the SPH models:

- 5-section ladder with 100' reach
- 1000-LB tip load dry and 500-LB tip load when the waterway is charged
- Roof ladder is mounted to the first section of the 5-section ladder
- Can be short-jacked with a single firefighter
- Has Stokes basket arms underneath the bucket
- Twice as much scene lighting compared to the SP models
- Ground ladders are stored on the beam inside a compartment. By moving ground ladder storage inside the apparatus body, compartment space doubled compared to SP models
- Added outrigger controls on the officer's side of the vehicle
- Bigger bucket
- Shorter turning radius
- Wider jack spread than the SP models or the Tillers
- Total jack spread is 22' from jack-to-jack
- The total length of one fully-extended outrigger is 6' 7"

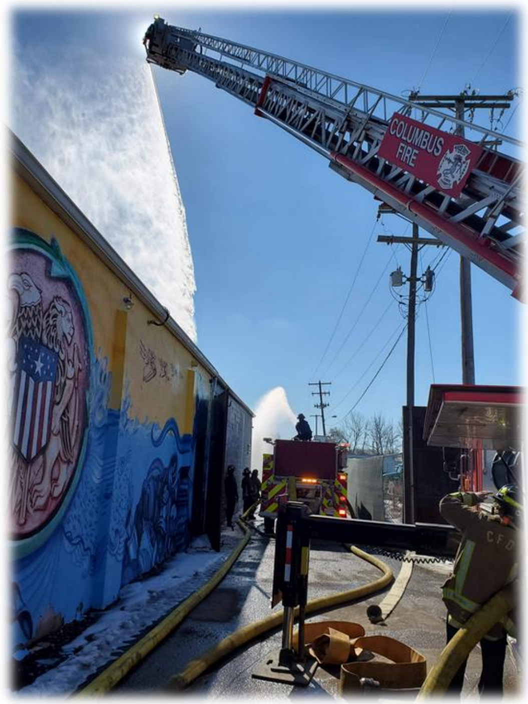
<u>Current SPH Models</u>

- 2
- 10
- 22
- 23
- 26
- 32
- 33



REVIEW

The Columbus Division of Fire Ladder Committee is constantly working on improving these trucks for the Division's firefighters. For each different year of the truck, the committee has often changed things from the previous year. Some of these changes are minor, and others are big changes that are noticed Division-wide. In this manual, not every minor detail will be discussed about the differences in individual trucks. All firefighters must take the time and effort to know their individual trucks at their stations. However, some of the general considerations that are sometimes forgotten will be reviewed below:



- All CFD platforms have a rated capacity of 1,000-LB tip load dry, and a 500-LB tip load with water in the waterway
- All CFD platforms have a 1,500 GPM rated pump but are capable of discharging up to 2,000 GPM. None of them have water tanks or pre-connects. Platforms must have a water supply prior to putting the pump in pump gear or the pump could be damaged and fail
- On the SPH models, placing the pump in pump gear removes the ability to use the high idle function for the aerial
- On the SP models, the switch on the pump panel must be moved from aerial to pump if the pump is going to be used
- Firefighters must know how to open and close the nozzles on the bucket. Make sure the nozzles are closed before charging the waterway
- Firefighters must be familiar with the upper power switches on the Platform they are operating for the day. If there is an upper power switch on the turntable to send power to the bucket, the general recommendation is to keep this on at all times. Doing so allows the operator to proceed immediately to the bucket for deployment once the outriggers are extended
- Ensure the ladder is completely bedded and fully retracted before driving the apparatus
- In the winter, open the drains to ensure there is no water in the pump. Firefighters can shut them after they ensure the pump is drained
- Make sure the waterway drain is open when retracting the ladder to prevent blowing the seals on the waterway
- All CFD platforms have a 35-MPH wind rating
- The stokes basket arms are rated at a max weight of 400-LB per pair
- Max weight of 500-LB in the bucket if the stokes arms are being used
- When setting up the truck, the jacks can no longer be operated once the safety pins have been placed into the jack. PIN THE JACKS LAST!
- Bedding the bucket—once the bucket is in the cradle, use the High Idle to make sure the bucket is completely bedded

TILLERS

OVERVIEW

As of 2021, the Division has fourteen tillers in its fleet, nine of which are serving as front line vehicles. Every one of these tillers are outfitted with heavy duty aerial ladders with a minimum tip load of 750 lbs. The Division currently has two different manufacturers of the tillers in its fleet, American LaFrance and Pierce. The city purchased the first three American LaFrance ladders in 2001. American LaFrance ran into financial troubles throughout the early 2000s, and eventually they closed their doors permanently in 2014. The city purchased its first three Pierce ladders in 2012 because of the new technological advances of Pierce’s apparatus combined with American Lafrance’s looming financial problems. The ladder manufacturer can be easily distinguished by the color of the aerial ladder. There are various differences between the aerials, specifically when looking at the manufacturer. When looking at trucks from the same manufacture group, there will be changes from different purchase years as technology has changed. The Ladder Committee is continually seeking to improve upon previous designs in the hopes of creating the best truck possible for Columbus firefighters to use.

AMERICAN LAFRANCE/LTI TILLER

As mentioned previously, the City of Columbus started purchasing TDAs (Tractor Drawn Aerials) from American Lafrance in 2001. The cab of the truck was built by American Lafrance, and the Aerial was made by LTI (Ladder Tower Incorporated). All these trucks have a 110’ aerial reach and a four-outrigger setup. These trucks are easily identified from a distance by their aerials, which are painted white.

The ALF tillers require more steps to stabilize the truck for use of the aerial due to the four outriggers and the safety pins that must be installed for each outrigger. The four lockout cylinders that come down and put pressure on the fifth wheel will also take more time than the newer Pierce aerial’s fifth wheel lockout system.

[Click here to view a video on how to set up an ALF/LTI tiller]

A few things to remember about some common occurrences when setting up the ALF tillers are shown below:

- Make sure the outriggers are extended all the way out on the working side. Remember that both outriggers will not operate at the same speed
- Make sure there is enough pressure on all the jacks once they are lowered. A green light in the outrigger control box will inform the ladder operator that the outrigger is fully extended and the jack has enough pressure on it. Double check the lights; they may come off after raising the opposite side
- If operating the aerial ladder and hydraulic power is lost, check the 5th wheel lockout light in the outrigger control box. The ladder driver may have to hit the down lever until the green light comes back on

PIERCE TILLER

In 2012, the city started purchasing tillers from Pierce. One of the most significant changes from the Lafrance tillers was the transition away from the four-outrigger setup to a two-outrigger setup. All Pierce tillers have two outriggers that can be operated from either side of the truck. These trucks are easily identified from a distance by their gray aerials. These trucks have a fifth-wheel lockout system that stops the transfer of fluid in the cylinders that are connected to the trailer and tractor, which locks the fifth-wheel.

This system is a lot faster to engage and disengage than the older stabilizer system on the ALF tillers. When looking more closely at the Pierce tillers from different purchase years, firefighters will notice they do have some differences. For example, some of them have 105' aerials and some have 107' aerials.

Another change between the first-generation Pierce Aerials and current generations is how the Aerial is stowed/bedded. First-generation Pierces use visual indicators to stow the aerial properly, via the red arrows from the turntable operator's perspective. Newer generation Pierce Aerials have a feature that automatically aligns the Aerial as it is lowered into the cradle. A visual indicator was included also in case the auto bed feature fails (Photos from L-8).

[Click here to view a video on how to set up a Pierce tiller]

These are just a few changes to be aware of. As mentioned in other sections of this manual, each individual detail cannot be covered in depth. The next few pages will discuss some considerations specific to the Tiller Aerials.

TILLER REVIEW

The primary advantage of the Tiller is its maneuverability compared to the Platform. This added maneuverability comes at the cost of requiring two firefighters to communicate and work together to utilize this maneuverability properly. ***<u>Communication is the key.</u>*** When driving and tilling these trucks, firefighters should make sure they use the buzzer system they were taught in the Training Academy. This section will list some topics that are more specific to operating Tiller ladder trucks; many of these could be included during morning checks of the apparatus. Some of the topics mentioned below will be a refresher, and other topics may be completely new or have been forgotten by those who are not assigned to a Tiller.

<u>Buzzer Controls</u>

Always use the buzzer system when driving or tilling these trucks:

1) Stop
2) Go
3) Back-Up

Although the headsets provide direct communication, members should be comfortable operating via the Buzzer system in case the driver or tiller headsets fail. Drivers have left the station without their tiller firefighter in the seat; the buzzer system adds an extra layer of safety/confirmation that the tiller operator is present and ready to move.

<u>Driver Mirrors</u>

Tiller drivers should make sure they are watching the trailer in their mirrors, especially **during** turns and **after** turns. It can be easy to lose track of turns as the tiller firefighter; the driver should be constantly aware of the truck's position behind them to help guide the tiller firefighter around obstacles if need be.

<u>Waterway Controls</u>

Leaving the waterway intake valves open or closed can be a company dependent decision. Leaving these intakes closed can prevent a prematurely charged supply line from discharging a master stream into personnel or other unintended property.

Nozzle Position

To add to the previous point on waterway controls, firefighters must make sure they know where the nozzle is pointing **before** charging the waterway. This rule applies to all Aerial streams, but it cannot be overemphasized. The photo to the left shows firefighters in a platform being hit by an aerial stream from a tiller.

Pinning the Aerial

Make sure the waterway is pinned in rescue mode during morning checks. Having the truck pinned to water mode could lead to the monitor obstructing the Aerial positioning during victim rescue. Older tillers had an actual pin that was moved to change where the waterway was attached to. New Pierce tillers have a *Quick-Lock Waterway*. Firefighters must familiarize themselves with how to change the waterway position, and they must verify it is secured.

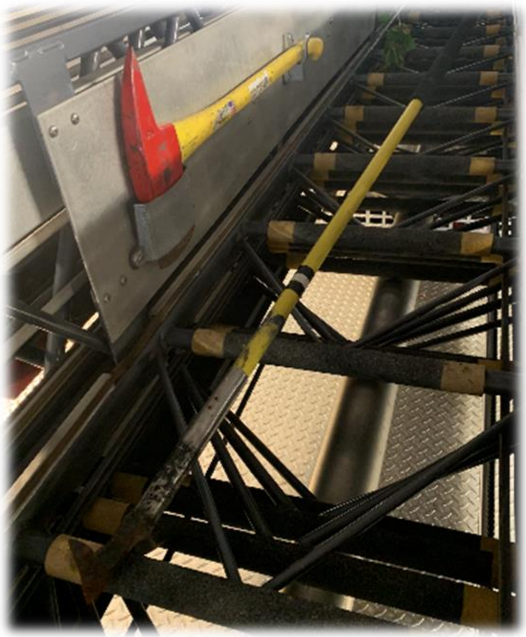
Jack-Knife Alarm

Firefighters must understand the Jack-Knife alarm and how to prevent Jack-Knifing the truck. This light will activate to inform the Driver and Tiller firefighter the truck is approaching Jack-Knife; they will need to perform corrective actions to prevent body damage.

Turntable Controls

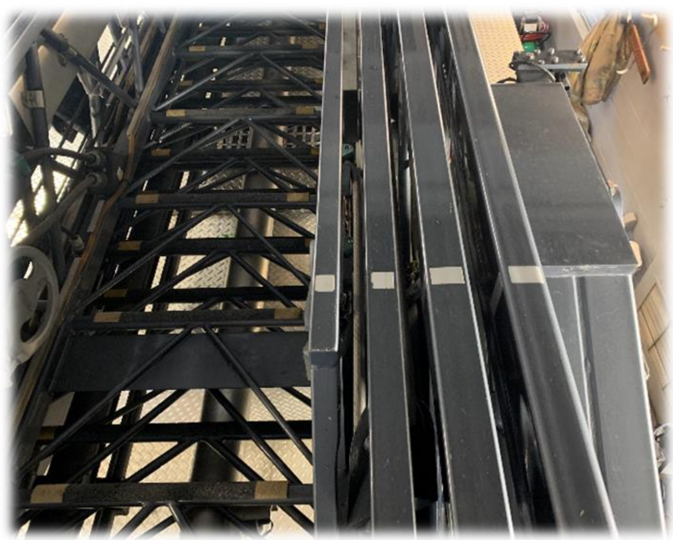
Make sure to feather the controls when using the aerial ladder. First generation Pierce Aerial ladder controls (left photo) are true hydraulic levers. Sudden stops with these levers will correlate to sudden stops in aerial movement, which will lead to more reaction at the tip. The newer Aerials have controls similar to the platforms, where sudden stops are accounted for by allowing the aerial to drift slightly rather than stopping suddenly.

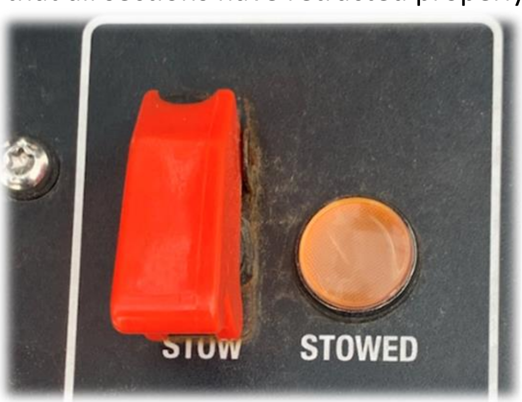
Climbing Safety
Operators must make sure no one is climbing the aerial ladder while they are moving the aerial. The sections of the ladder have several points where they will be crossing each other when extending or retracting the aerial. A hand, foot, or piece of equipment can easily be caught during movement and cause serious harm to the firefighter or aerial.



Check Aerial Equipment
Make sure the pike pole and axe are secured in their bracket before moving the aerial. While generally secure, brackets may become less secure though normal wear and tear. This could lead to a tool dislodging into the ladder. Moving the aerial without recognizing this could lead to damaging the aerial.

Check Aerial
When bedding the ladder, make sure it is fully retracted before lowering it below the tiller box. The aerial alignment indicators shown to the right help confirm to the operator at the turntable that all sections have retracted properly.





Nozzle Stowing
Make sure the nozzle is stowed in the correct position before bedding the ladder. CFD aerials are equipped with a nozzle stow switch, but these have malfunctioned in the past. Always visually confirm the nozzle is in the correct position before bedding the aerial.

Outrigger Extension

Make sure the outriggers are fully extended on the working side—the side the aerial is moving to. Each aerial has indicators to alert the operator if the outrigger is not fully extended, and there are safeties in place to prevent rotation to the short-jacked side. Notice in the photo to the right that the indicator light is not on for the driver side stabilizer, meaning that outrigger is not fully extended.

Fifth Wheel Lockout

Make sure the fifth wheel lock is disengaged on the Pierce Aerials, and the lockout cylinders are up on the ALF ladders. The stability these provide during aerial operations could cause body and frame damage if left engaged during driving.

Jack Pads

Jack pads should be used at all times when operating the aerials to help prevent soft or unstable surfaces from upsetting the truck.

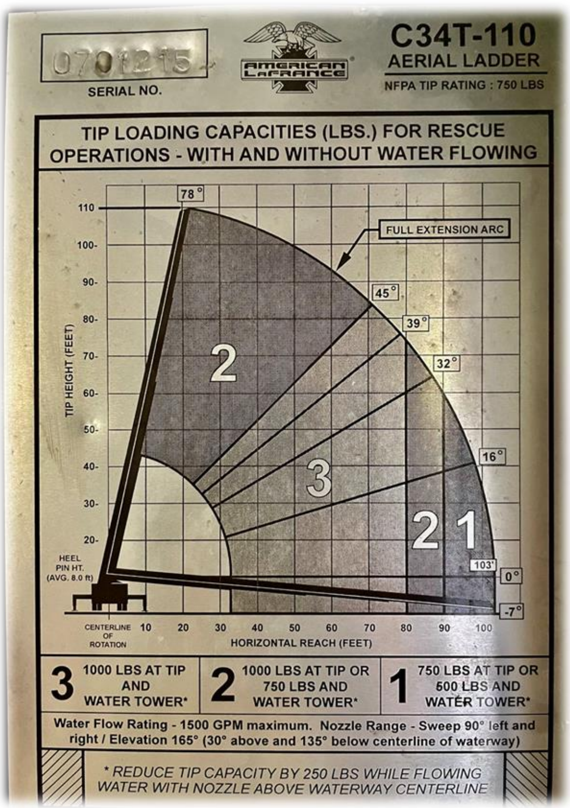
Aerial Loading

CFD Tillers and Platforms are designed in a way that they are meant to work with downward forces applied. This means that the aerial should remain unsupported and should not be set down onto a ledge, roof, etc. that would cause upward pressure to be applied to the aerial.

<u>Tip Loads</u>

Tip load is the maximum amount of weight allowed at the tip of the aerial. The tip load changes depending on the angle and extension of the ladder. When referring to tip loads, the terms **<u>Dry</u>** and **<u>Wet</u>** are used. Dry means that there is no water in the waterway, and wet means that there is water in the waterway. Most CFD tillers have a dry tip load of 750 lbs. when the ladder is at max extension and max elevation; however, the American Lafrance tillers have a dry tip load of 1,000 lbs. at max extension and max elevation. The Pierce tillers have a dry tip load of 750 lbs. at max extension and max elevation. Every ladder has a “load chart” that is usually mounted somewhere on the pedestal; this load chart tells the operator how much weight is allowed at the tip based on the current operating conditions. The ladder driver must know how to read these load charts; doing so will tell the ladder driver how much weight they can have on the aerial ladder. The Pierce tillers have a digital read-out on the pedestal that states the dry and wet tip load of the ladder.

American LaFrance Load Chart



Pierce Digital Load Chart

SHORT-JACKING

OVERVIEW

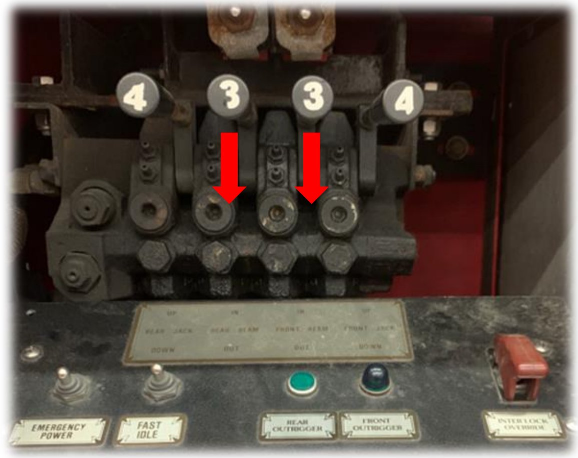
When positioning and setting up ladder trucks, firefighters will ideally take a position that allows all the truck's outriggers to be fully extended. Unfortunately, situations will arise where firefighters will not have the necessary space to fully deploy the truck's outriggers. Short-jacking provides firefighters with an option for overcoming these limited space situations. Short-jacking occurs when the outriggers are not extended fully on one side of the truck to leave enough room to fully extend the outriggers on the opposite side. It is important to remember that short-jacking is only to be done on the non-working side of the ladder truck (If the fire is on the driver's side of the truck, then the officer's side of the truck would be the non-working side). **It is extremely important that firefighters ensure the working side of the ladder has its outriggers fully extended.**

All CFD ladder trucks have the capability to be short-jacked. Some of the ladders require the use of an override switch to short-jack the truck, while others may not. As long as the working side outrigger(s) are fully extended, the ladder will still have full capabilities on that side (working side). When the truck is short-jacked, **DO NOT** move the aerial ladder to the short-jacked side. All the CFD ladders have a safety system that should prevent firefighters from being able to rotate to the short-jacked side. However, these safety systems have failed in the past. It is extremely important for firefighters to know that once a ladder is short-jacked, **NEVER** attempt to rotate the aerial to the short-jacked side.

The following section will illustrate the procedures for short-jacking the different types of CFD ladder trucks. Firefighters should remember to spend time with the truck they are assigned to or operating for the day. Setting up the truck as intended with outriggers fully extended should always be done, if possible; however, operators should remain familiar with how to short-jack their aerial prior to arriving to an incident. Each truck manufacturer has their own unique procedure, and some trucks have their own quirks from time to time. Some companies may have normal or designated drivers; talking with them will often be the best resource for learning things unique to their specific truck.

AMERICAN LA FRANCE

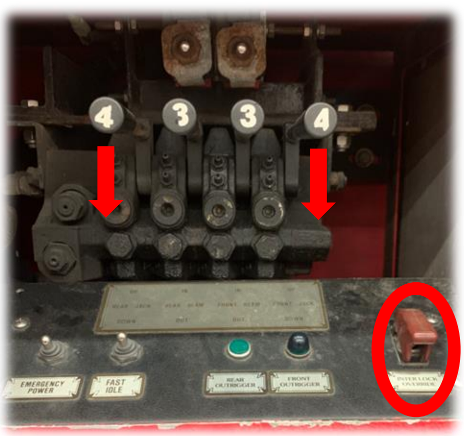
1) Place Transmission in Neutral
2) Engage Parking Brake
3) Push in Front Wheel Lock
4) Turn on Aerial Power
5) Turn on Aerial PTO
6) Check the passenger side for obstructions and chock the wheels

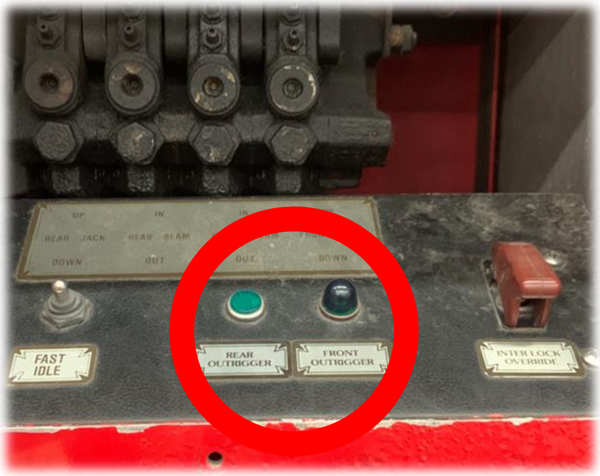


7) Extend the outriggers. The ALF outrigger controls only operate one side at a time. The driver's side compartment has a 5th lever which will operate the lockout cylinders for the Aerial. For the side that is being short-jacked, extend the outriggers as far as possible.

8) Place the ground pads as shown in the photo on the left. Ensure the handles are turned inward toward the truck. Having the handles turned outward away from the truck creates a potential tripping hazard.

9) Lower the outriggers. For the outriggers that are short-jacked, the driver/operator will have to operate the Interlock Override Switch. Lift the cover and hold the switch on while simultaneously operating the lever/s to lower the outrigger jacks.





10) Install the manual safety pins and proceed to the opposite side of the truck.

If the outriggers are fully extended, the green Outrigger Deployed Indicator Lights will come on when enough downward pressure is felt by the jack.

It is important to remember that when the outriggers are short-jacked then lowered, the green Outrigger Deployed Indicator lights will not activate.

11) Repeat the steps on the opposite side of the truck, ensuring the outriggers are fully extended if this is the working side. Place the ground pads and lower the outrigger jacks. Install the safety pins.

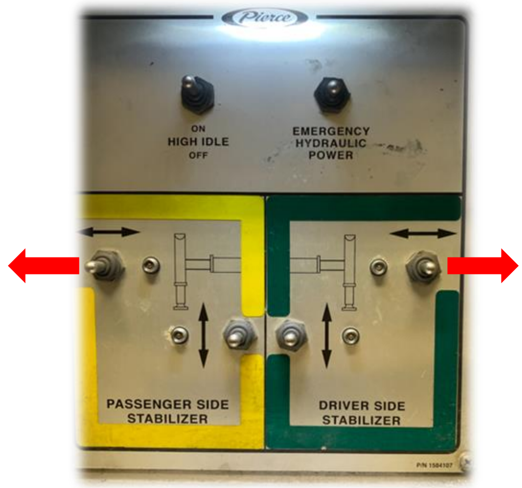
12) Lower the Lockout Cylinders. As mentioned previously, the Driver's side outrigger control box will contain the Lockout Cylinder Control Lever. The cylinders will drop at different rates.

Hold the Lockout Cylinder Lever until the green Lockout Cylinder Indicator Light comes on. This light indicates that all four cylinders have come down and applied enough downward pressure

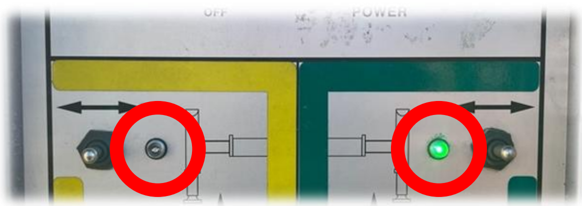
13) Proceed to the turntable and prepare to raise the aerial. Notice that some red lights will be activated (photos above). Some models have a red Outriggers Not Deployed Indicator Light showing which side is short-jacked. An additional red Outriggers Not Deployed Light may be found near the Override Switch. The Override Switch will need to be held during any attempted movement with the Aerial; the controls will not operate without this due to the truck being short-jacked. Depending on the year of manufacture, this switch may be labeled as Aerial Override. As a safety feature, the truck should not allow the aerial to move more than a few degrees toward the short-jacked side even with the Override Switch held.

Click here to view a video on how to short-jack the ALF/LTI tillers

PIERCE TILLER



1) Place the transmission in neutral
2) Engage the parking brake
3) Push in the Front Wheel Lock
4) Turn on the Aerial Master Switch
5) Check the passenger side for obstructions and chock the wheels
6) Extend the stabilizers. The Pierce ladders allow the operator to visualize the passenger side stabilizer being extended. If short-jacking one of the stabilizers and you are unsure about the space available, ensure you are operating the controls on the same side to have direct visualization of the space available. Failure to do so could lead to accidentally extending the stabilizer into an obstacle, potentially damaging the stabilizer. Extend the short-jacked stabilizer as far as possible; ensure the opposite side (working side) outrigger is fully extended. *Note: The indicator light will come on once the outrigger is fully extended; short-jacking will cause this light to remain off*
7) Place the stabilizer jack pads
8) Lower the stabilizers until the indicator lights come on for both stabilizers, indicating the stabilizers are on firm ground. Again, the light for full extension of the short-jacked outrigger will remain off



CFD Pierce ladders have Passenger Side Controls, similar to the ALF ladders. These controls are a mirrored image of the Driver Side Controls. The main difference between Pierce controls and ALF controls is that on a Pierce the operator can run both the Driver side and Passenger side stabilizers from either side of the truck. This allows for an operator to run each side if desired, or a single operator can closely monitor the side they are short jacking. Unlike the ALF stabilizers, the Pierce stabilizers do not have safety pins.

Another feature that often goes unnoticed is that the stabilizer control panels are color coded to the side of the truck the operator is on. Green represents the outrigger on the same side of the truck as the operator. The above left photo is from the driver's side, because the driver side stabilizer controls are outlined with green tape. The opposite is true on the passenger side as shown in the above right photo. This extra visual indicator helps drivers ensure they are operating the intended side at 3 am when operating on little or no sleep.

9) Engage the 5th Wheel Lock-Out System. Driver/operators should ensure that the lever is fully seated into its bracket.

10) Raise the Aerial. There should be no overrides needed for the Pierce Tillers when they are short-jacked. The operator can simply proceed to the turntable and place their foot on the dead man's switch (Except for the newer generation Pierces that do not have dead man's switches) and proceed to raise the aerial.

The operator should be able to operate the Ladder anywhere on the fully extended stabilizer side of the Tiller. The Aerial should have an interlock that will prevent the operator from rotating beyond the center line to the short-jacked side of the truck.

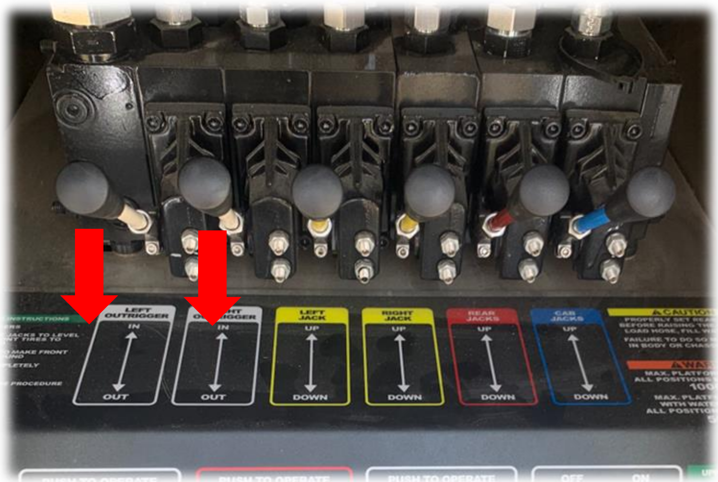
SUTPHEN-SPH100

Steps for short-jacking are as follows:

1) Place transmission in Neutral
2) Engage the parking brake
3) Engage PTO Lad/jack switch
4) Check passenger side for obstructions; place the wheel chocks

[Click here to view a video on how to short-jack platforms]

5) Extend the outriggers; the working side must be fully extended. Extend the short-jacked side as far as possible. Ideally, the operator would be able to extend the short-jacked outrigger far enough to access the safety pin for the jack



6) Lower the outrigger. CFD Sutphen platforms allow the operator to lower the outrigger while it is still fully retracted. The outrigger should always be extended as much as possible on the short-jacked side. Ideally, this distance would be far enough to allow access to the safety pin (18 inches of extension needed to access the safety pins)

7) With at least one outrigger fully extended and the other outrigger partially extended, place the jack pads and lower the jacks until the bulge is out of the front tires

There are separate controls for the officer's side outrigger located behind a panel next to that outrigger. This feature is found on most newer CFD platforms. This feature is especially helpful when short-jacking the officer's side of the truck; it ensures the operator has direct visualization of the outrigger to avoid hitting obstructions

8) In a previous step, the operator lowered the outrigger jacks until the bulge was out of the front tires. Now, the operator should lower the rear jacks until the bulge returns to the front tires
9) Lower the cab jacks

10) Now that the outriggers and jacks are in place, the upper power switch can be turned on. The jacks can then be pinned. As mentioned previously, the short-jacked outrigger may be left in and unpinned during extremely limited space scenarios. If the outrigger is not pinned, the alarms will not stop, since only one jack is pinned

Raising the Aerial from the Bed

During normal setup with both outriggers fully extended, pinned, and the upper power switch turned on, the operator could raise the aerial from either the turntable or the bucket. If the operator attempts to raise the aerial while short-jacked, the aerial will not move. Short-jacked operations require the operator to override the truck's interlocks through one of two options:

- Interlock Override Buttons
- Manual Valve Control

Interlock Override

Depending on the year the truck was manufactured, there may be a different number and location for the Interlock Override buttons. Older CFD ladder trucks had two override buttons:
1) Located at the outrigger controls
2) Located at the turntable controls

Newer CFD ladders have three of these buttons (photos on next page). Two buttons are in the same location as listed above, and a third button was added to the control panel in the bucket.



Using the Interlock Override requires two personnel to raise the aerial from the bed. Old trucks require the buttons to be pressed simultaneously while the firefighter at the turntable operates the lever to raise the aerial. Once the aerial is raised from the bed, the warning alarms should stop; the operator can then operate the aerial like normal from the bucket without holding the Overrides. For newer trucks with 3 override buttons, at least 2 out of the 3 buttons would need to be pressed. **ONE OF THE 3 BUTTONS MUST BE THE OVERRIDE BUTTON LOCATED NEXT TO THE OUTRIGGER CONTROLS**. This allows an operator to be at the turntable or in the bucket. Once the aerial is raised out of the bed, the operator can then proceed with normal operations.

Manual Valve Control

Directly below the turntable controls is a small access panel. Behind this panel are three control levers (photo below on the right) and a red override button (photo below, second from right) to the left side of the compartment. When the operator needs to raise the ladder while short-jacked without a second firefighter readily available, they will need to access this panel.




To raise the aerial while short jacked, the operator must press and hold the red override button, then operate the turntable control to raise the aerial. Once raised high enough from the bed, the audible alarms should stop and the operator can operate the truck like normal.

The truck will maintain full capabilities on the side of the truck with the outrigger fully extended, and it should not allow the aerial past the center line to the short-jacked side of the truck. No overrides will be needed to bed the ladder, but the alarms will activate again once bedded.

EMERGENCY POWER UNIT (EPU)

OVERVIEW

Every CFD ladder truck has a backup hydraulic motor to operate the Aerial and Outriggers. Depending on the truck and model (Aerial/Platform, Pierce/Sutphen), this motor may be called the Emergency Power Unit (EPU) or the Emergency Auxiliary Hydraulics. The purpose of this unit is to allow firefighters to operate the aerial and the outriggers if the vehicle's engine or main PTO (Power Take Off) unit fails. The EPU motor is electronically powered and runs off of the trucks 12v battery system.

If the truck's main engine or the PTO stopped working, this could leave the aerial or firefighters on the tip in a compromised position during an active incident. This back-up motor could then be operated to move the aerial, preventing it from being damaged by heat if it is stuck close to a fire. If there is a failure of a major component (engine, PTO) during non-emergency operations, the ladder will need to be taken to the shop for maintenance. The EPU can be used to stow the outriggers and aerial so the ladder can be towed to the shop.

These EPU/Auxiliary motors should be run during Monday checks and after every 10 hours of aerial use. Doing so helps circulate oil in the system and ensure the unit is working properly. There are some differences between various CFD trucks (Aerial/Platform, Pierce/Sutphen) as to how these motors are operated. Remember that these motors are intended only for stowing the aerial and outriggers, and they will operate much slower than the primary hydraulic motor. They have a limited run time and can overheat quickly; it is important to ensure that the appropriate cooldown cycles are followed to ensure the motor does not fail.

It is important to remember the proper sequence when using all EPU motors. The EPU is essentially a small starter motor; it will not handle resistance as well as the normal hydraulic motor. Prior to engaging the EPU, ensure the desired movement lever or button is engaged. This will ensure there is a pathway for the hydraulic fluid to move through, rather than dead heading at the EPU motor. Essentially, if the firefighter wants the aerial to retract, the firefighter would move the retract lever first, then engage the EPU. To stop the movement, the order should then be reversed. The firefighter should release the EPU switch first before releasing the movement control lever/button.

AMERICAN LAFRANCE

For the ALF ladders, the EPU switch can be found with the stabilizer controls on the driver's side, labeled as "*EMERGENCY POWER*". Older (2001) ALF ladders may only have this switch in this location. Newer ALF ladders (2008) may also have another switch located on the turntable controls (Example: Ladder 1 turntable-third photo on the right). The Emergency Power switch has power to it at all times, even when the truck's ignition switch is off.

<u>Operating the EPU</u>

1) Select the desired motion by holding the corresponding motion control lever (For example: Rear Jack In)
2) Push and hold the EMERGENCY POWER switch to activate the EPU motor. At that point the firefighter should be able to hear the EPU motor running
3) To stop the motion, release the EMERGENCY POWER switch before releasing the motion control lever
4) Repeat until the outrigger has been properly stowed

If stowing an Aerial without an EPU switch on the turntable, two firefighters will be required for the operation. One firefighter will need to place themselves at the turntable controls to select the desired motion using the lever controls, and the second firefighter will need to be on the ground to run the EPU switch. The firefighters will need to work together to coordinate turning the EPU on and off while operating the controls.

If the ladder has been short jacked and the aerial is still up, the Override switch will need to be operated also to bed the aerial with the EPU.

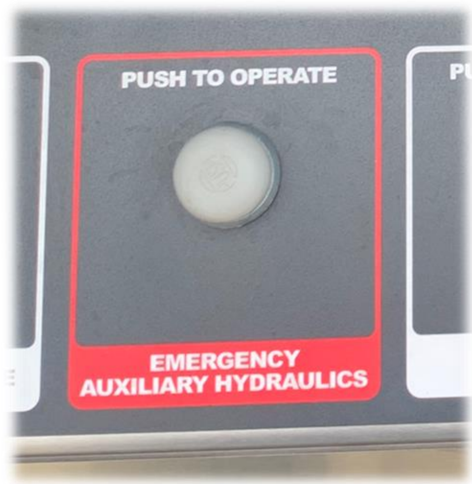
<u>Duty Cycle</u>

The EPU on the ALF ladders can be operated for up to **<u>2 minutes</u>** at a time; after 2 minutes of use the EPU must be **<u>off for 7 minutes</u>** to keep the EPU from overheating.

PLATFORMS

On the Sutphen Platforms, the EPU switch is labeled as “EMERGENCY AUXILIARY HYDRAULICS.” This switch is a push button style; it is found in the box containing the outrigger controls on the driver’s side of the truck (photos below). Unlike the American LaFrance aerials, the EPU switch on the Sutphen platforms requires the truck’s ignition switch be in the “ON” position for the EPU to operate.

Platforms with the lever controls for the outriggers have a standalone button for the EPU as shown in these two photos



Platforms that have the push button style outrigger controls instead of the lever style controls will also have a button that controls the EPU (Emergency Auxiliary Hydraulics). However, this Emergency Auxiliary Hydraulics button will not be a standalone button like the one in the photos above. Instead, it will be a small push button by the Hi Speed button (see photo on the right).

Emergency Auxiliary Hydraulics

1) Turn the truck’s Ignition Switch to “On” to provide power to the Emergency Auxiliary Hydraulics button
2) Select the desired motion by holding the corresponding lever (For example: Retract the platform)
3) Press and hold the Emergency Auxiliary Hydraulics switch. At that point, the firefighter should be able to hear the EPU motor running
4) Once the desired motion is complete, the firefighter should release the Emergency Auxiliary Hydraulics switch first
5) Release the motion control lever/button
6) Repeat these steps for any desired movements until the aerial is properly stowed. Firefighters should ensure cooldown times are allotted for

Duty Cycle

The EPU on Sutphen Platforms can be operated for up to **2 minutes** at a time; after 2 minutes of use the EPU requires a **5 minute cooldown.**

PIERCE

On the Pierce aerials, the EPU switch is labeled as "Emergency Hydraulic Power." These switches are located within the outrigger control boxes and on the turntable. These switches operate the EPU motor on the truck similar to the other aerials. However, these switches will not function unless the Battery, Ignition, Front Wheel Lock, Parking Brake, and Aerial PTO are all on/engaged. These Emergency Hydraulic Power switches would be used when the truck's engine or primary hydraulic motor failed, but there is still electrical power to the controls (Indicator lights would still be on).

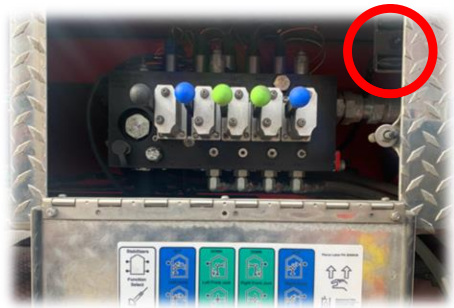
Emergency Hydraulic Power

1) Ensure all necessary switches are on (Battery, Ignition, Front Wheel Lock, Parking Brake, Aerial PTO). This provides electrical power to the controls
2) Select the desired aerial or stabilizer motion by moving one of the motion control levers
3) Engage and hold the Emergency Hydraulic Power switch to operate the EPU motor
4) When the desired motion is complete, release the Emergency Hydraulic Power switch
5) Release the motion control lever
6) Repeat these steps until the aerial is properly stowed

The photo to the right shows a firefighter operating the Emergency Hydraulic Switch on the turntable to retract the ladder while the truck's engine is not running.

Aerial/Stabilizer Emergency Power

In addition to the Emergency Hydraulic Power switch, there is a different Emergency Power Switch located on the driver's side of the ladder. To the right of the driver's side outrigger control box, there is a panel. Behind this panel are the manual valve controls and the Emergency Power Switch, which is located in the upper right corner. (Photos on the right are from Ladder 8). This Emergency Power Switch operates the same EPU motor as the Emergency Hydraulic Power switch discussed on the previous page. However, the Emergency Power Switch would be used for a more significant failure of the truck's systems. For example, if the truck's engine, primary hydraulic motor, and the electrical system to the outrigger/turntable controls have all failed, the Emergency Power Switch could then be used. The Emergency Hydraulic Power Switch mentioned on the previous page would be used when there is still electrical power to the controls. The Emergency Power Switch mentioned here is used when there is no electrical power to the controls, and it requires only the battery switch to be on.



Operating the Emergency Power Switch

1) Ensure the truck's battery switch is turned on to give power to the switch
2) Select the desired motion, whether at the turntable or at the outrigger controls (the turntable will require one firefighter to run the Emergency Power Switch and another firefighter to run the turntable controls)
3) Once the desired motion control lever is engaged, move the Emergency Power Switch up for Aerial Emergency Power or Down for Stabilizer Emergency Power
4) Once the desired motion is complete, release the Emergency Power Switch first before releasing the motion control lever
5) Repeat the process until the Aerial is bedded and the Outriggers are stowed

Duty Cycle

The EPU motor on CFD Pierce ladders is rated to run for **30 minutes of use**; it should then be allowed **30 minutes of cooldown time**. Firefighters should remember that operations will be much slower when using the EPU.

SCENE LIGHTING AND GENERATORS

OVERVIEW

Although firefighters probably will not be nominated for an award for providing lighting at a fire scene, they should take lighting up a fire or accident scene very seriously. Columbus Fire has come a long way with their lighting plans over the years. From the truck mounted scene lights, cord reels, and 500-watt quarts lights on both sides of the truck, technology has advanced rapidly over the last several years. These advancements in technology have given CFD ladder companies greater capabilities on various scenarios, ensuring they always have lights readily available for fast deployment.

Good scene lighting is not to be underestimated, and it should not be limited to more serious incidents like structure fires. Proper scene lighting has proven to be invaluable on various other scenes such as service runs, auto accidents, EMS calls, etc. Scene lighting not only serves to help responders; it can also help civilians be more aware of emergency responders. This is especially true on freeway incidents at night. Firefighters never want to work at a dark scene if they do not have to.

Part of a firefighter’s job is knowing when to have scene lighting on, and when not to have it on. Driving to a service run at 1 am for a CO Alarm does not require the entirety of the truck’s scene lighting capabilities. The toggle switches are placed on the truck for a reason; scene lighting does not have to be an all-or-nothing use.

Caution: *If firefighters are not on an Emergency Run, they should not be driving around haphazardly with the brow lights and scene lights on. Think about your family driving in their own vehicle and suddenly being blinded by the scene lights. While scene lighting is important, firefighters must take the time to ensure the lighting is directed appropriately and not causing more harm than good. If firefighters are on an Emergency Run with their red lights on, civilians “should” be yielding to the truck. Brow lighting should be off when driving to the emergency. Once near the scene, the brow light can be turned on to help illuminate the scene.*

TRUCK MOUNTED SCENE LIGHTS

Truck mounted scene lights are shown in the photos below—lights on the left and right sides of the truck, front brow lights, and rear lights. These truck mounted scene lights are capable of being used when nearing arrival to the scene, in addition to our emergency lighting. This extra lighting can help firefighters locate street signs, addresses, and alleyways. By parking in the front, rear, or adjacent to the scene, firefighters can take care of rapidly lighting up all or a majority of the scene.

<u>Aerial Scene Lights</u>


<u>Platform Scene Lights</u>

The above images show a general overview of truck mounted scene lighting. The truck mounted scene lights should be the same on each side of the truck. Depending on the truck's year of manufacture, firefighters may notice changes in the lighting options that are available on scene. The next page will illustrate some examples of differences in lighting options between newer and older apparatus.

Light Towers

Night-Scan- Found on trucks prior to 2008

Command Light- Found on trucks 2008 and newer. These command lights, found on both platforms and tillers, are an elevated lighting platform mounted to the cab of the truck. These provide large amounts of scene lighting that can be easily deployed with a controller. The Division is currently switching away from these due to reliability issues and pricing; they are not found on newer apparatus models.

Tip Lighting

Tip lighting (left photo) will also vary depending on the year the truck was manufactured. This lighting can help illuminate the roof firefighters are about to step on at night. The tip lighting also provides a more easily identifiable egress point for firefighters on the roof. Tip lighting controls are found at the turntable pedestal.

Aerial Lighting

In addition to lighting at the tip, all Division ladders will have lighting on the aerials to help illuminate the aerial itself for positioning and climbing. Newer apparatus are also equipped with scene lighting pointed downward (above left photo). Platform lighting is placed on the bottom of the bucket itself (above right photo).

ON-BOARD GENERATORS

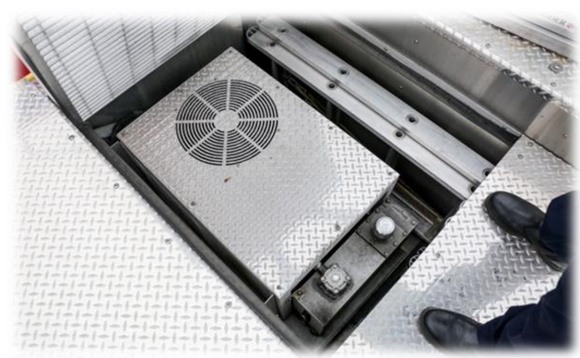
All Columbus ladders have onboard generators that can be operated both while driving non-emergency and when responding to a scene. These on-board generators are operated independently of the emergency lighting. Generators supply electric to the scene lights, cord reels, and outlets mounted to the exterior of the apparatus and within the compartments. Some trucks require the truck's fuel level to be above ½ for the generator to run. This is intended to prevent the generator from causing increased fuel consumption and emptying the primary fuel tank. These on-board generators can be powered by one of the following two ways: Diesel driven or PTO driven.

Diesel Driven Generator

<u>Diesel Driven</u>

- Photos of a diesel driven generator can be seen above
- Can be started and stopped in the cab, or in the compartment by the Breaker Box
- These generators draw fuel from the same tank as the ladder's engine
- Can be started and stopped while driving

<u>PTO (Power Take Off) driven</u>



- These types of generators use power directly from the engine's drivetrain to power a hydraulic motor in the generator
    - Does not require a fuel source, but is completely dependent on the ladder's engine working properly
- Can be started and stopped in the cab
- Can be started and stopped while driving
    - The PTO driven generators are connected to the drivetrain and require the engine RPMs to be under 1100 RPM to engage the hydraulic motor
    - Drivers may hit the PTO HYD GEN button when driving. When idling up to the scene, the hydraulic generator will turn on once RPMs drop below 1100 RPM

Starting the On-Board Generator

Depending on the truck year and manufacturer, there may be multiple ways to start and stop the on-board generator. Platforms will generally have a switch in the cab for the driver. Tillers may have one for the tiller firefighter and also have one in the back-up generator compartment.

Automatic Transfer Switch

Some of the truck's outlets are connected to an automatic transfer switch. This switch automatically selects from either the shore line (if plugged in) or the generator (if turned on), to send power to these outlets. If a firefighter unplugs the shoreline and starts the generator, this switch automatically transfers the outlets over to generator power (instead of the shoreline power) without the firefighter having to do anything. By doing so, this provides a constant supply of power to these outlets that can be helpful for charging spare batteries and for keeping fresh batteries on standby. The photo on the left shows the L-32 compartment with their Automatic Transfer Switch located to the right of their breaker box. They have walkie batteries and Milwaukee tool batteries on chargers.

Note: *Once the batteries are fully charged, they should be taken off the chargers if the chargers are connected to an automatic transfer switch. Some batteries have a built-in memory that will count charging cycles. This means that every time the truck is plugged in or the on-board generator is started, the battery counts this as a new charging cycle. This can lead to wasted charging cycles shortening the battery life.*

Breaker Box

Once the on-board generator has been started, the electrical power is sent to a breaker box similar to ones found inside residential houses. The breakers are left in the on position; this ensures that the lights and outlets are available to operate and supply power as soon as the generator is turned on.

BACK-UP GENERATORS

Most (not all) CFD Ladder companies are outfitted with a back-up generator to provide power if the primary generator fails. There are two models of back-up generators firefighters may encounter:

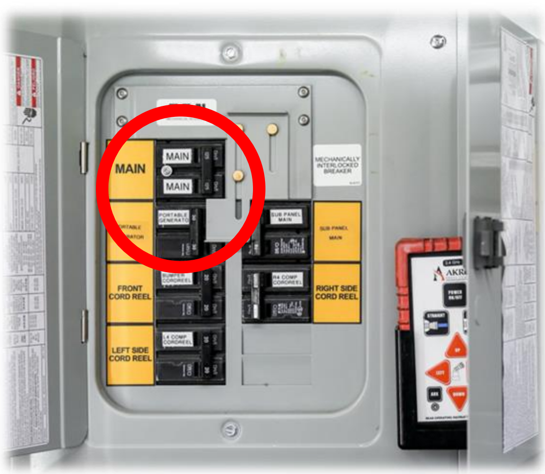
- Honda EB 5000X
- Honda EM 6500SX

For any CFD Ladder outfitted with a back-up generator, the back-up generator should be inspected as part of Monday checks, at the very least, to ensure it is in good working condition. If the on-board generator is working as it should, crews only need to do routine checks on the back-up generators. If the on-board generator fails, there are a few steps crews will have to perform to transfer power from the back-up generator to the truck.

Transfer Switch

Moving power from the back-up generator to the truck requires the use of a transfer switch. There are several variations of transfer switches found on the various ladders:

- Some Transfer Switches are located within the breaker box itself
- Other Transfer Switches are completely separate in their own breaker box or have a standalone switch



The photo on the above left shows a transfer switch built into the primary breaker box. The photo on the above right shows the manual transfer switch as a standalone junction box.

These photos of Ladder 8 show another style of transfer switch. Position 2 in the photo on the right is for operating off of the on-board generator, and Position 1 is for running off of the back-up generator.

Auxiliary Feed

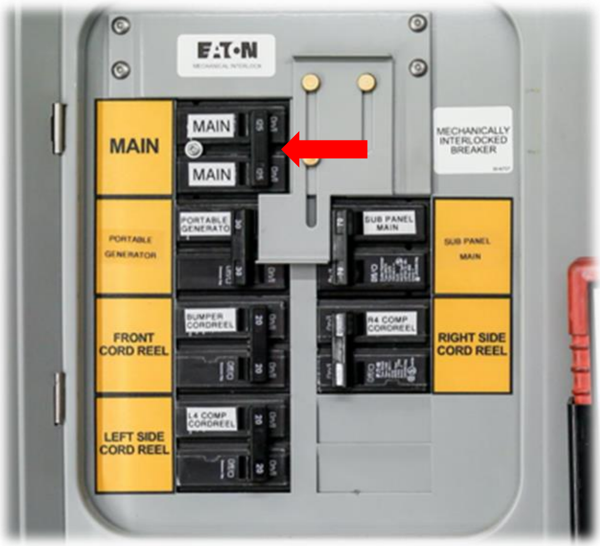
To feed power from the backup generator into the truck, an auxiliary inlet is located in the backup generator compartment. Note: not all ladder companies will have an auxiliary feed connection for back feeding the truck. For instance, L-10 currently has a backup generator but has no way to back feed the truck.

- There should be a short cord in the compartment with the back-up generator. This cord will be used to make the connection between the back-up generator and the auxiliary inlet on the truck. Photos of the auxiliary inlet are shown below

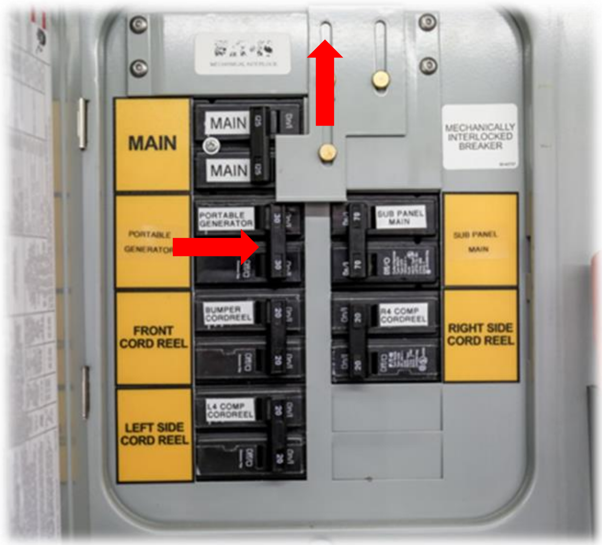
The photo on the left shows the cord that is used to make the connection from the backup generator to the auxiliary inlet on the truck. Note that this cord is a 4-prong Hubbell twist lock.

SWITCHING TO THE BACK-UP GENERATOR

1) Turn off the breaker for the main generator by flipping the switch indicated by the arrow in the photo below



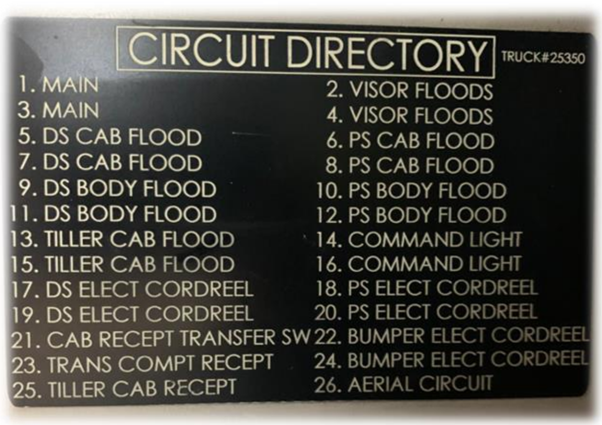
2) Slide the locking device up to allow the auxiliary breaker to be flipped on as shown by the arrows in the photo below



3) Start the back-up generator. Remember that all backup generators have the capability of being pull-started. Some models have a turn start function, but this will only work if the generator has been run recently and for long enough to maintain a charge for its internal battery

4) Connect the backup generator to the truck using the short cord. The cord will plug into the back-up generator with one end and into the auxiliary inlet on the truck with the other end as shown in the photo on the left

5) Turn on only the lights and receptacles that are needed in order to operate on the scene. Note: the auxiliary generator will not be able to power all the lights on the ladder truck at one time; firefighters have to be selective on what is needed.

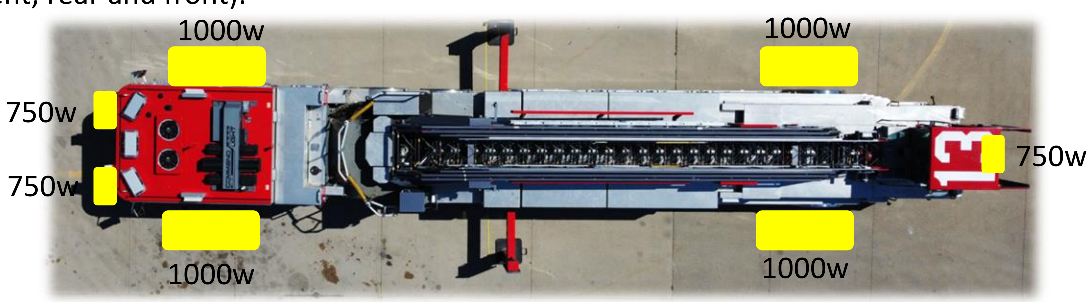


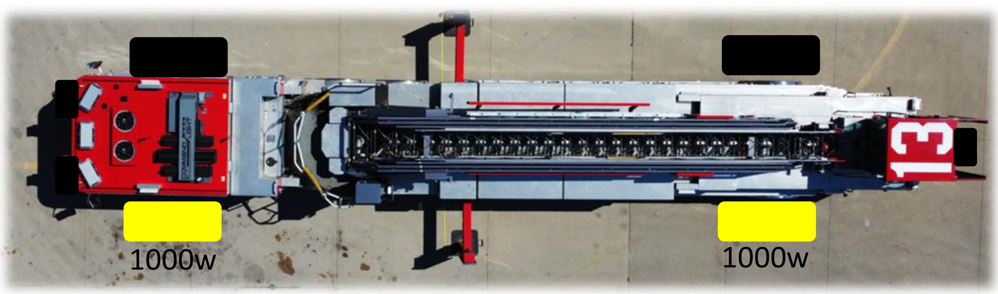
RUNNING OFF THE BACK-UP GENERATOR

In a situation where the primary generator has failed, operators should familiarize themselves with operating off of the backup generator if their truck is equipped with one. As mentioned previously, the backup generators do not have the same capacity to run all the electrical equipment and lighting as the on-board generators. Operators will need to be mindful of this and prioritize what equipment they wish to run off of the backup generator, otherwise they could quickly overload the generator.

<u>Example:</u>

Currently, the majority of CFD scene lighting is provided via Halogen bulb lighting. CFD is currently in the process of switching over to LED lighting on newer ladders; however, CFD will still have halogen lighting for years to come. The image below shows the general scene lighting provided by a Tiller ladder, as well as the power required to run the lighting. With all the truck mounted scene lighting on as shown in the top image, a total of 6,250 watts would be needed to run this amount of lighting. This would exceed the capabilities of our backup generators. Operators would then need to flip off breakers to lighting and equipment that is not required (side opposite of the incident, rear and front).





Shutting off lighting not essential to the scene could reduce the power usage by 4,250 watts if the incident were isolated to the driver's side. With only 2,000 watts now being used, the backup generator still has enough left over supply to provide power to other lighting and equipment (such as a cord reel to a ram fan or quartz lighting).

Newer CFD Ladder apparatus are being outfitted with LED scene lighting. Ladder companies that have these newer LED lights are L-1 (in production), L-8, L-28, L-2, and L-26. These lights are capable of running off of the trucks 12v battery system, similar to engine company scene lighting. This means that the on-board generator will only be running cord reels and some lighting on the aerials themselves. Drivers should understand the power demands of their equipment, know which lighting and equipment runs off the battery, and know which lighting and equipment runs off the generator.

LIGHTING PLAN FOR A STRUCTURE FIRE

OVERVIEW

Like any other task, lighting plans for a scene will change according to the needs and priorities of each specific scene. Below is a general thought process for providing lighting at a typical residential house fire. While lighting will be more critical for nighttime incidents, operators should not forget the need to ensure power is available for junction boxes in order to provide power to other electrical equipment.

EN ROUTE TO THE SCENE

Many companies will start their on-board generator while responding to the incident. This can help ensure the on-board generator is working properly and notify the crew of a mechanical failure prior to arrival. Crew members could then go straight to using the back-up generator if an issue is discovered with the on-board generator while en route to the scene. The truck mounted scene lights can also help illuminate obstacles, especially for the driver and tiller firefighter as they attempt to navigate tight turns, alleys, and streets.

ARRIVAL ON SCENE

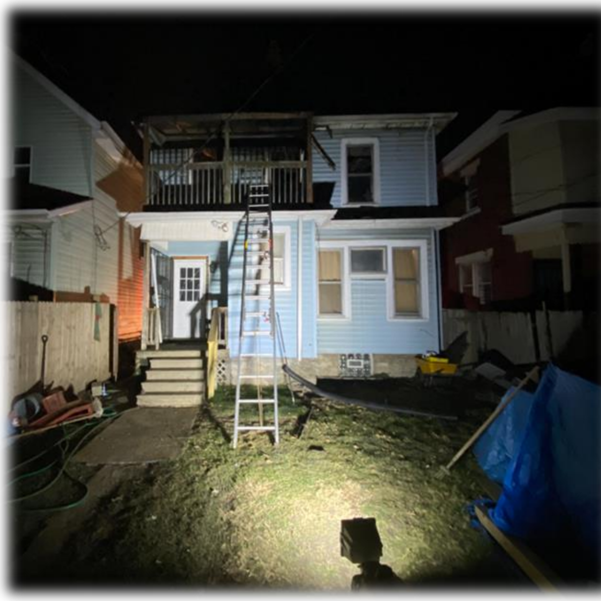
Truck mounted scene lights will often take care of a majority of the initial scene lighting. With the area around the truck lit by the truck mounted scene lights, the driver could then run a cord reel with a junction box to the front of the house. The junction box only needs to be near the front entrance; as much care should be taken as possible not to obstruct the front entrance. Hose teams will give little thought to stepping on cords and junction boxes while advancing attack lines. Look to see where the hose line is going to be stretched, and try to keep the cords away from the hose.

500-watt quarts lights can be placed in first floor and second floor windows away from hose lines. If it is necessary to use the front door, try to keep lights and cords off to the side of the door. The photo to the left shows an example of the importance of lighting. After cutting a roll-up door on a Type III building, crews placed a light and found that a majority of the first floor was missing on this side of the building.

Quartz lights give firefighters the option of stringing several lights together in succession, providing a large amount of lighting from a single power source. Something to consider, especially after the incident is over, is the heat generated by CFD halogen bulb lighting. A 500w halogen bulb can generate heat over 570°F. Crews should consider this when storing the lights and cords after an extended operation. Give the lights time to cool prior to storing them. Many crews store their lights with an extension cord around them; this heat can easily damage and melt the cord’s outer layer if left in contact with a hot light.

Battery lights are making it easier for crews to provide good scene lighting in shorter amounts of time. In the photo to the left, crews were operating on a commercial roof chasing fire in the rubber membrane. The aerial tip lighting did not have access to this portion of the roof, and it would have been too far for a cord reel to reach. Crews were able to carry several Milwaukee lights up the aerial, which provided enough lighting for the duration of the incident.

The Tiller/OSV firefighter can easily carry a 20’ or 24’ ladder and several of these lightweight battery lights to place in the back yard or back door. These lights can also be placed in the first floor, upstairs, and basement windows. Honda lights also provide large amounts of lighting from a single source for the rear. The photo to the right shows a Honda light lighting up the rear of a residential structure fire. The Tiller/OSV firefighter was able to carry a ground ladder and the Honda light to the rear. The lighting helped firefighters navigate overhead wires with the ladder, and helped firefighters rescue a victim who was trapped on the second story after awaking to fire and smoke blocking the interior stairs.



At commercial buildings, the Tiller/OSV firefighter should open all doors and openings and place a light inside. These lights are a great indicator of a way out for any crews operating inside the building.

“You’re only as Safe as your Last Known Exit.” John Norman-FDNY

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FIREFIGHTER ASSIGNMENTS OVERVIEW

TRUCK OPERATIONS MANUAL

SECTION TOPICS

Firefighter Assignments Overview

Ladder Officer Responsibilities

Inside Firefighter Responsibilities

Ladder Driver Responsibilities

Tiller/Outside Vent Firefighter Responsibilities

SECTION OBJECTIVES

Identify the basic responsibilities of the Ladder Company Officer

Identify the basic responsibilities of the Inside Firefighter

Identify the basic responsibilities of the Ladder Driver

Identify the basic responsibilities of the Tiller/Outside Vent Firefighter

FIREFIGHTER ASSIGNMENTS OVERVIEW

OVERVIEW

- This section of the manual will provide brief descriptions of the responsibilities of each ladder crew member. While it is understood that not every firefighter has a passion for truck company operations, every firefighter is expected to be proficient when placed in that role
- On a ladder company, the ladder crew will split into two teams, an inside team and an outside team, the majority of the time when on scene of a working fire
- On larger commercial incidents where the Incident Commander assigns the ladder company a task, the ladder officer may need to decide whether that task requires the entire crew instead of splitting the crew into two teams
- Responsibilities may vary depending on the size of the incident, the tasks that need to be accomplished, and whether the building is residential or commercial

CONTENTS

- Ladder Officer Responsibilities
- Inside Firefighter Responsibilities
- Ladder Driver Responsibilities
- Tiller/Outside Vent Firefighter Responsibilities

LADDER OFFICER RESPONSIBILITIES

OVERVIEW

One of the biggest differences between an engine company officer and a ladder company officer is that on an engine company the entire crew is normally with the engine company officer on a hose line, with the exception of the pump operator. Normally the engine officer gives the crew instructions on hose line selection and tactics prior to entering the structure. On the ladder company, the crew splits up into two teams, an inside team and an outside team, the majority of the time. However, on larger commercial buildings the ladder officer may decide to keep the entire crew together to complete a task, rather than splitting into two teams. If the crew is split into two teams, the ladder officer is generally not able to work with and directly supervise the outside team. The outside team must be able to make decisions independently, without freelancing, to prioritize tasks that will support interior companies. The ladder officer is still ultimately responsible for the actions and safety of the outside team, even though the officer is not working directly alongside them on most fires.

PRIOR TO THE EMERGENCY

The ladder company officer has to know the various jobs of the ladder company: searching for fire and victims, laddering the building, forcible entry, ventilating the structure, salvage and overhaul, etc. The ladder company officer must also ensure that the firefighters on their ladder company are proficient at their jobs. Just because someone has 20 years on the department and transfers from an engine company to a ladder company does not mean they will be proficient at ladder operations. It is the job of the ladder company officer to ensure that all members assigned to the ladder company achieve and maintain proficiency in all aspects of ladder operations.

PRIOR TO THE EMERGENCY CONT.

It may be difficult for a relief officer temporarily transferred to a ladder company for the day to figure out the capabilities of a ladder crew they have never worked with. Consider asking the crew what their gameplan is for various scenarios, such as a VEIS scenario. Discussing possible scenarios before they happen will help the officer get on the same page as the crew, work more cohesively with them, and understand what actions the crew is likely to perform on a fire scene. In addition to discussing possible scenarios, make sure the crew knows your expectations as the officer. Having these discussions will not take long, but it will go a long way toward ensuring the crew will be able to achieve their objectives on an emergency scene.

The officer should ensure the Inside Firefighter understands what is expected of them. If the officer is planning to carry the Halligan and the TIC, advise the Inside Firefighter to bring at least a striking tool, pike pole, and a water can. The officer should be prepared to direct the Inside Firefighter to the area of the structure where they want to prioritize the search. The officer should also ensure the outside team (Driver and Tiller/OSV Firefighter) understands what is expected of them. The outside team will have to make decisions on their own, without the benefit of their officer always being there to guide them. When an outside team gives the officer the proverbial “Ladders, Lights, and Fans” answer when asked what is expected of them on the scene of a house fire, the officer should question the outside team further to ensure they understand the priority of these tasks. Some simple rules for actions the outside team should take on a single/double, wood-frame, residential structure fire could include the following:

- Place ground ladders in the rescue position to windows on all four sides of the structure
- Perform forcible entry to doors and windows as needed. Remove bars or other obstructions on windows that would keep interior companies from being able to rapidly exit in an emergency
- Position the apparatus for roof ventilation, whether ventilation is currently needed or not. By doing so, the outside team will be prepared to immediately ventilate if the Incident Commander requests vertical ventilation
- Determine the type(s) of ventilation that are needed—vertical, horizontal, or mechanical. A combination of the three types of ventilation may be necessary
- Control utilities as needed. If a rescue company is on scene, the outside team should coordinate with the rescue to determine which utilities still need to be shut off
- Place lights as needed. During a sunny day-time fire, lights could still be placed at points of egress such as doors and windows to help interior firefighters quickly locate an exit if conditions change for the worse. At night, the outside team could place lights on each side of the structure to eliminate trip hazards or to make it easier to see hazards such as downed power lines
- Prepare for salvage and overhaul. The officer can assist the outside team by letting them know exactly what is needed inside, such as salvage covers, shovels, trash cans, or more assistance opening up walls to search for hidden fire
- As the situation is contained, the outside team should have the fan ready for positive pressure ventilation. The officer should ensure the outside team knows not to start the fan until requested by the ladder officer, other interior crews, or the Incident Commander

TOOL SELECTION

The officer on the ladder will normally carry a Halligan, TIC, and a hook. It is important for the officer to be proficient at using all three tools. This list of tools is only a starting point; it by no means limits the officer from choosing to carry additional tools based on the specific needs of the situation.

<u>Halligan</u>

- The Division has several different styles of Halligans
- The officer needs to know the different uses and applications for the Halligan
- The officer should ensure the Inside Firefighter carries a striking tool that can be used in conjunction with the Halligan for forcible entry needs
- See the Forcible Entry section of this manual for additional information

<u>Thermal Imaging Camera</u>

- As of 2021, the Division has three different models of TICs
- Remember that the TIC can fail; do not be solely dependent on the TIC
- In very smoky environments it can be difficult to see the screen
- Officers should decide and train on where they are going to attach the TIC to their PPE
- The TIC can be used inside or outside the structure
- The FLIR TIC is the most common model used currently
- Click here to view the Target Solutions video on Functions of the FLIR Thermal Imaging Camera

<u>Hook</u>

- Officers should carry the type of hook that works best for them
- Officers can choose what length of hook to carry. If carrying a longer hook, the officer does not need to drag it with them the entire time they are searching as it could impede progress

ON SCENE CONSIDERATIONS

The officer should be sizing up the building when arriving at the scene of a fire. Some of the things the officer should be considering upon arrival and throughout the remainder of the incident could include the following:

<u>Where is the fire located? Does the engine company know its location?</u>

It is the ladder company's job to find the fire and let the engine company know where it is. As first due companies arrive on scene, they will often know, or at least have a general idea, where the fire is located in the structure based on visible fire venting from the structure. Visible fire venting as companies arrive should help us feel more comfortable because we know where the fire is. If first due companies arrive and see heavy black smoke pushing out of a structure with no fire showing, the ladder companies will have to assist the engine company with finding the seat of the fire. Depending on the building size and layout, the ladder company may be able to find the seat of the fire more quickly by going ahead of the hose line and performing reconnaissance. The ladder company can then relay the location of the fire back to the engine company. Moving ahead of the hose line without the protection of the engine company's water can be dangerous. At any point when going ahead of the hose line, the ladder company officer must keep a few things in mind:

- Always remember where the last known exit is
- Listen to radio traffic; the Incident Commander may see fire conditions changing for the worse from the outside and relay that to interior companies
- Know where the closest charged hose line is
- If you have a gut feeling that you should start backing out, always go with your gut feeling
- Always know what is going on above your head, especially in buildings with drop ceilings

<u>Is it safe to search this structure? If so, where is the best place to begin the search?</u>

The ladder company officer will have to decide if conditions allow for an immediate search in an attempt to obtain an All Clear on the structure, or if it is necessary to wait for conditions to improve prior to committing the crew to the interior. Putting water on the fire and/or ventilating the structure can significantly improve conditions inside. However, the longer it takes to find any victims trapped inside, the less chance of survival those victim(s) have. Unless it is a defensive fire, it is the ladder company's job to obtain an All Clear on the structure. At some scenes an occupant may tell arriving fire companies that everyone is out of the building. While it is important to share that information with all the companies responding to the incident, **<u>DO NOT SAY</u> "**We have an all clear per the occupant." Instead, just say "Occupant reports that everyone is out." Occupants do not perform primary searches. There have been multiple incidents across the nation where an occupant has stated everyone is out of the building, only for fire companies to find a victim in the structure later on.

<u>Is ventilation currently needed?</u>

Determine the type(s) of ventilation that are needed: vertical, horizontal, or mechanical. A combination of the three types of ventilation may be required. The ladder officer should be sure to coordinate ventilation with the engine company.

<u>What are the salvage and overhaul needs?</u>

After an All Clear has been given and the engine company has water on the fire, the Incident Commander will be counting on the ladder company to find and expose any hidden fire. Depending on the extent of the fire and the conditions inside, the ladder company could consider placing some salvage covers prior to opening up walls and ceilings. In some instances, too much damage may have already been done to the point that there is not a need for salvage. However, the ladder officer should ensure that the ladder crew tries to protect as much of the occupant's belongings as is reasonably possible.

INSIDE FIREFIGHTER RESPONSIBILITIES

OVERVIEW

The inside firefighter on the ladder company will be working in close proximity to the officer on most incidents. The inside firefighter and the officer (depending on staffing) make up the interior team. The inside firefighter should come off the truck on the officer's side. This allows the inside firefighter to be paired up immediately with the officer as soon as they come off the truck. The inside firefighter should be proficient at using multiple tools such as a Halligan, axe, sledge, pike pole, water can, hydra-ram, circular saw, chainsaw, search rope, etc.

FORCIBLE ENTRY

One of the first tasks for the inside firefighter on many incidents is gaining access to the structure. This could involve forcing doors, breaking/forcing windows, cutting gates, etc. Sometimes this will be simple as twisting the door knob, and other times it may be necessary to pry or cut plywood off the doorway of a vacant structure to get access to force the door open. After forcing the door, the inside firefighter will need to decide which tools to take into the structure, based on the needs of the situation.

SEARCH AND RESCUE

At most residential fires, the inside firefighter will be teaming up with the officer and searching the structure for victims and for the location of the fire. The officer should give the inside firefighter some guidance about where to start the search. A good guideline for the inside firefighter to follow is to stay in voice contact with the officer while searching. If a victim is found, the inside firefighter should size up the victim to determine if assistance is needed to remove the victim from the structure. Inform the officer of the location of the victim and any resources that are needed. The officer will radio to command that a victim has been found and inform command what locations still need to be searched.

SALVAGE AND OVERHAUL

After an All Clear on the structure is obtained, one of the next tasks that needs to be completed is searching for hidden fire. This could include opening up ceilings and walls, checking the floor above, and checking the attic for extension. Before opening up the structure to check for hidden fire, determine if now is a good time to put salvage covers in place to prevent damage to the occupant's belongings. The company officer has multiple things they are responsible for and they may not always think of salvage; sometimes a simple reminder about salvaging people's belongings can be helpful. If any hidden fire is found, ensure there is a handline present prior to opening up too much of the area where the fire is.

LADDER DRIVER RESPONSIBILITIES

OVERVIEW

Being the driver of the ladder truck is a **BIG** deal. Being a driver involves a huge amount of responsibility; it does not mean you just throw all your gear in a compartment and sign your name on the EL-69 for the day. Your crew, the engine crew, your chief, and the residents of Columbus are all depending on **YOU** as the driver to know your job and be good at your job. The driver must know the location of all the equipment on the truck, be familiar with its intended uses, and know how to operate each piece of equipment. The driver is also responsible for knowing how to operate and set up the truck under calm and stressful conditions. This section will discuss some of the responsibilities of the driver position on a ladder company at Columbus Fire.

EXCHANGING INFORMATION

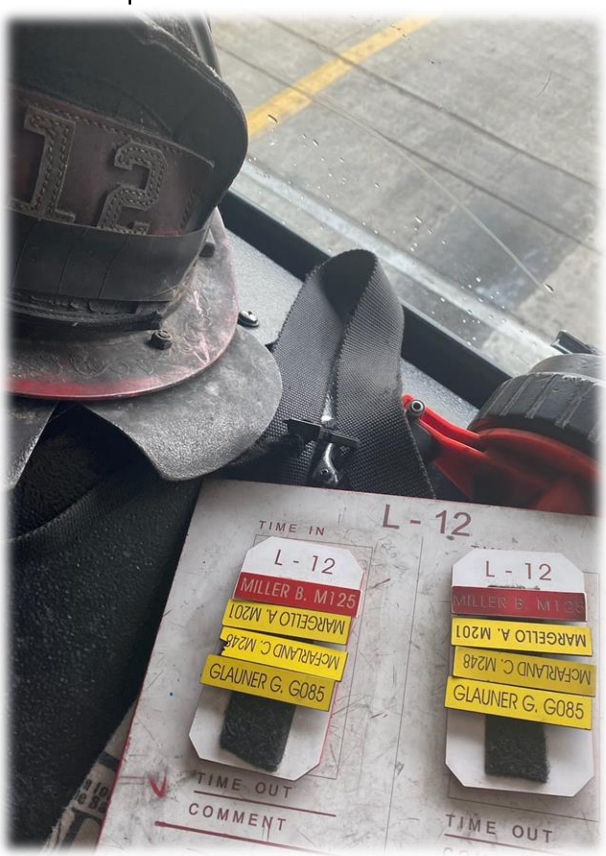
Many drivers begin the day by talking to the driver from the off-going shift. The driver from the off-going shift should pass on anything new about the truck or the equipment, and any other information that the on-coming driver should know. This is generally an informal handoff separate from roll call. This routine will vary from station to station and could include some of the following topics:

- Truck going to the shop for preventative maintenance, including any issues the shop repaired or was concerned about
- Any incidents concerning the ladder and any equipment used, such as a structure fire that occurred on their shift
- Information regarding the truck and its equipment should also be logged in the station log RL-104
- Missing or broken equipment, such as lights, hand tools, etc.

PERSONAL PPE

One of the first things firefighters should be checking once they are on duty is their PPE and SCBA, regardless what apparatus they are on or what position they are in on the truck. The order in which the gear is checked and how it is staged will vary from firefighter to firefighter. Common checks and gear staging include the following:

- SCBA is full (5500psi) and in good operating condition. The driver's SCBA should be stored in a position where the driver can rapidly don it to assist the Tiller/OSV firefighter with vertical ventilation as needed
- Helmet tag designation is accurate and PAR Tags are placed correctly on the accountability board
- Assigned radio should be preset to the most common fireground channel for your district; this removes an extra step for the 2am fire across the street



DRIVING IN GEAR

Driving in fire gear is a new concept to most firefighters at CFD. The fire service in general is very resistant to change, which results in many firefighters just “doing what we’ve always done.” The primary benefit of driving in gear is that it allows the driver to immediately go to work when arriving on scene. Everyone else on the ladder company exits the truck in full PPE, grabs their tools, and goes to work. The ladder drivers should be doing the same, or they will be delayed in completing their tasks in a timely, efficient manner. Many ladder drivers have fallen into the bad habit of wearing only a helmet and gloves at fires. There is a misconception that a ladder driver can safely operate in just helmet and gloves like an engine pump operator. SOP (01-04-01) states: “Minimum PPE to operate a pump or aerial device shall be helmet and utility gloves.” However, that same SOP states in the next line: **“When working in the hazard zone, apparatus operators shall don full protective clothing for structural firefighting.”** Ladder drivers are required to do much more than just operate the aerial. While working outside, the ladder driver will be in the hazard zone—throwing ladders, cutting roofs, venting windows, etc. Even simple tasks like placing fans and lights put the ladder driver in the hazard zone. The SOP explicitly states that full PPE must be worn in the hazard zone.

The decision to drive in just bunker pants, or in both bunker pants and coat, should be based on a few different factors. Ladder drivers will need to determine if their coat fits comfortably enough for them to safely perform all functions while driving the apparatus. If it does not, the ladder driver should not be driving with their coat on. For drivers of a TDA, are you waiting for the tiller firefighter to get completely dressed and climb into the tiller box? If so, then the driver has plenty of time to don pants and coat. The tiller firefighter has to climb up five steps to get in the tiller seat; the ladder driver only has to step up two steps to sit in the driver’s seat. Ladder drivers need to consider all these factors when deciding if they are going to drive in bunker pants and coat or just in bunker pants.

When dispatched on fire related emergencies, the ladder company officer and crew don their gear prior to leaving the station. The driver can be using this time to do the same thing. Just as the driver cannot make up time getting to the scene by driving fast, they are not going to gain any time by getting dressed on scene. If anything, time is wasted by not driving in gear. Why wait until the scene to don gear, when it can be donned with the rest of the ladder crew at the station? Again, this may seem like a foreign concept to many who have never driven in pants and coats. However, prior to the CFD policy change of no gear in the sleeping quarters, many firefighters kept their bunker pants next to their bed at night, donned them when a run was dispatched, and drove in bunker pants. On snowy days, many drivers of ladders and engines wear their bunker pants to drive. In many metropolitan fire departments of similar size to CFD, it is not only recommended, but required, that ladder drivers must drive in gear.

DRIVER CHECKS

The driver is ultimately the person responsible for making sure the truck and its systems are checked in the morning. The driver's name and ID number will be on the EL-69. Performing a morning check of the truck and its equipment is an important part of the day for the driver, and doing so can help ensure the rest of the shift goes smoothly. The crew is counting on the driver to make sure the truck is in good working order. Most drivers will begin their vehicle checks in the cab after checking and staging their PPE. The order and method for checking the vehicle will vary from driver to driver; checking the truck will become more routine with time and experience. Below are some general considerations for checking the apparatus each morning. This is certainly not an all-inclusive list; the apprentice firefighter should ask experienced members of their crew for further guidance on checking the truck.

Inside the Cab

- Begin by turning on the battery and ignition and checking the gauges that can be checked without the truck's motor running. At some point the motor will need to be running to check some of the gauges
    - Air pressure—If the motor is off and the air pressure is below 70 PSI, start the engine to ensure the pressure will build to 120 PSI
    - Voltmeter—Reading should be between 13 and 14.4 when the motor is running. The minimum reading is 12.8 (which is when the load manager starts shedding accessories)
    - Fuel—Should be above a half tank
    - DEF—Should be above a half tank
    - Oil pressure—Normal operating range is 40-60 PSI (Around 20 PSI at idle)
    - Engine temperature—190°F - 212°F
    - Transmission temperature—160°F - 200°F
- Drivers should know what the normal ranges are for our equipment to allow them to recognize when readings are not in an acceptable range

Inside the Cab cont.

- Drivers should determine if any abnormal readings are something that can be corrected at the station, or if the truck needs to be taken down to the shop for repair
- Adjust your mirrors and seat to your liking
- Check the oil dipstick to make sure it is within the acceptable range (This does not require the cab to be tilted)
- Check to ensure the Jake brake is on and the load manager is on
    - Load Manager—sheds unnecessary electrical components when activated. It will start with those items that draw the most current, such as the air conditioning or heater, followed by the next most demanding loads that are draining power from the electrical system

Lights

- Turn on all the lights including the headlights, high beams, hazards, and emergency lights (Primary and secondary) that run off the battery
- The parking brake needs to be released to get all the emergency lights (Including the white flashing lights) to come on. The driver could have another firefighter sit in the driver's seat with their foot on the brakes and the parking brake released while the driver checks those lights
- With all the lights on, the driver should do a complete 360 inspection around the vehicle

Body

- Check for any damage to the vehicle. If damage is found determine if it is new, or if it is damage that was already there and has been previously documented
- Damage to trucks should be recorded in the EL-69 when it occurs or at least when it is found
- Touch every tire as you walk around the truck to remind you to visually inspect it. Check the tire pressure weekly to ensure tires are inflated to the correct pressure

Equipment

Since the driver is responsible for the vehicle and the equipment on it, the driver must have an intimate knowledge of what is supposed to be on that truck. Just like knowing normal limits when checking the gauges, the driver can recognize if something has changed by knowing where each piece of equipment belongs. The entire ladder crew should assist with equipment checks, but the staffing for that day can alter how checks are performed. If a TT or trade not assigned to that station is working for the day, they will most likely not recognize if equipment is missing from a compartment when performing checks. The driver should notice if something is missing during equipment checks. Many stations keep equipment lists specific to that vehicle listing all the equipment that should be within each compartment. These equipment lists can be especially helpful when changing over into a backup vehicle or when learning the apparatus as an apprentice firefighter on rotation. The scene of an emergency is not the time to discover that something is missing or not working correctly. For a full description of equipment checks and how they should be performed, refer to the Equipment Check section of this manual.

FIRST DUE LADDER DRIVER RESPONSIBILITIES

One of the driver's first jobs after being dispatched on a run is knowing how to get to the scene and getting the truck and the crew there safely. We cannot help anyone if we are not able to arrive safely at the scene. When arriving on scene, one of the most important responsibilities for the ladder driver is to spot the truck in the best position where it can be used effectively. Spotting the truck is a skill that will take years of practice and experience to perfect. Refer to the Spotting the Truck section of this manual for more detailed information on this topic.

Once the ladder is positioned appropriately, the majority of the ladder driver's responsibility at emergency incidents will involve operating as a member of the outside team. The outside team will consist of the driver and the tiller/outside vent firefighter. Depending on staffing, the outside team could also include the fifth/swing firefighter. **Whenever the outside team is operating in the hazard zone, full PPE must be worn (SOP 01-04-01).** Just as SOPs determine apparatus duties based on their arrival order to a scene, outside teams should have a preplan for most of the incidents they go on. After arriving on scene, the outside team may have to adjust their plan or change it completely; other scenes may require little or no deviation. The outside team will need to prioritize tasks based on each situation and will be operating without the direct supervision of the company officer the majority of the time. The outside team will have to make many decisions on their own; rely on training, experience, and common sense to make those decisions.

Residential House Fires

The driver is responsible for throwing at least two ground ladders on buildings with two or more floors. The building layout and the fire location will dictate where the driver places these ground ladders. If the structure is a house in the inner city with a porch roof on the alpha side, the driver should consider laddering this porch roof first to give the inside crew the option of going straight to the second floor to begin their search. The driver's second ladder could then go to a window on the bravo or delta side. If the interior crew decides they are going to do a VEIS to the bravo or delta side, the driver's first ladder should then go to that location for VEIS.

Next, the driver should determine if there are any forcible entry needs on the first floor besides the door that the first engine already made their entry into. If there are not any immediate forcible entry needs, the driver should start preparing for natural ventilation. Vertical ventilation is the best form of natural ventilation, but it takes time to complete. If vertical ventilation is being considered, the driver needs to be working toward that task immediately after throwing ground ladders. It is better to be prepared to do vertical ventilation and not need it than to not be prepared when crews need it. The driver needs to decide if the vertical ventilation will be performed from the aerial, platform, or from ground ladders. The driver positioned the truck upon arrival and should know if the turntable is in a good position to use the aerial or not. If the decision is made to use horizontal ventilation, be sure to consider the location of the fire. **Always coordinate any type of ventilation with interior companies.** The need for ventilation is a continuous task that will need to be evaluated multiple times throughout the duration of the fire scene.

After natural ventilation has been completed, the driver can start working on fans and lights. Ideally, the second ladder has arrived on scene by now and is helping out with these tasks. Depending on the specific ladder company's tool complement, the lights and fans could be powered either by battery or by electricity from the truck's generator. **Never turn on the positive pressure fan until interior companies say they are ready for it.** Normally interior companies will call for the fan after they have water on the fire. After placing lights and a fan as needed, the driver should check with the interior companies to see what they need inside, such as salvage covers/plastic, attic ladder, pike poles, trash cans, shovels, etc.

<u>Apartment Building Fires</u>

The driver's first task is throwing ground ladders, unless there is a victim that needs to be rescued using the aerial ladder or platform. Just because someone is at a window screaming for help does not mean they are in danger. Is smoke coming out that window? Are they in the unit above the fire apartment? Those are some things the driver should be thinking about when trying to prioritize what needs to be done first on scene. If no one needs to be rescued, the driver should be laddering the fire apartment and the exposure apartments. While laddering the building, the driver should also be doing a size-up to determine what type of ventilation will be needed and if the interior companies need anything else done before ventilation is performed. When choosing what type of natural ventilation to use, pay attention to the extent of the fire and how fast it is moving. Is it contained to one apartment, or is it in multiple units? Is it in the attic and starting to spread horizontally? If it is in the attic, the outside crew should consider performing vertical ventilation from the aerial or platform to keep the fire from continuing to spread horizontally. If it is a small kitchen fire contained to one unit, then horizontal ventilation should be adequate. **As always, coordinate ventilation with interior companies.** After natural ventilation has been performed, the driver should start thinking about what task needs to be done next. Depending on the incident, the next task could be taking salvage covers (plastic) to the front door for companies to use inside or getting fans and lights to the incident. If interior operations are not going well, the next task could be preparing for master stream operations. Listen to the interior companies on the radio; they will likely notify the outside crew of any specific needs via radio.

Commercial Building Fires

Commercial building fires are very different from routine residential fires. At many commercial fires, the driver will spend a lot of time doing some type of forcible entry in the beginning of the incident. This could include using a saw to cut roll-up doors or using the saw to get a man door open. One of the ladder company's primary objectives is to get the building opened up so crews can get inside, but more importantly this allows crews to have multiple points of egress. Once the building has been opened up enough for the incident, the outside crew will have to decide if the openings are sufficient for ventilation or if more ventilation is needed. Ventilating commercial buildings can present many different challenges. Some commercial buildings do not have many windows. Cutting the roof of a commercial building takes a lot more time, staffing, experience, and training than cutting a residential roof. Firefighters cannot cut most commercial roofs from the safety of an aerial or bucket because most commercial roofs are flat roofs. Commercial buildings are also hard to ventilate because of their size. In smaller structures, wind or positive pressure fans can be used to move fresh air into the interior of the building. However, CFD fans do not move enough air to effectively ventilate most commercial buildings. Some townships have big fans on trailers that the incident commander can call for to assist with ventilation in these large commercial structures.

Depending on the size of the incident, the entire ladder company might be assigned a task at some commercial fires, instead of having the crew split into two teams. Some examples of a task the entire ladder company might be assigned could include forcing all the overhead doors on a particular side of the structure, ventilating the building using whatever method the ladder company officer chooses, or forming a fire attack group by teaming up with an engine company. When the entire ladder company is assigned a task, the driver and tiller/outside vent firefighter will stay with the officer and inside firefighter to operate as one crew.

Prior to Leaving the Emergency Scene

The driver is responsible for making sure all the equipment that was used at the scene is back on the truck prior to leaving the scene. Depending on the incident, this may require the driver to open every compartment and make sure everything is in that compartment that is supposed to be in there. The crew can help make this job easy for the ladder driver by making sure any tools or equipment they took off the truck gets put back on the truck. Also, a good guideline for any firefighter that takes tools off any other trucks on the scene is to let the driver of that apparatus know. Doing so allows that driver to keep a mental list of what has come off their apparatus during the incident.

TILLER/OUTSIDE VENT FIREFIGHTER

OVERVIEW

Tiller/OSV firefighters work outside the structure, along with the driver. Some of their primary job duties include ground ladders, ventilation, forcible entry, and lighting. Tiller/OSV firefighters should assist the driver with positioning on emergency scenes. Before exiting the tiller cab, the Tiller Firefighter should communicate with the driver to ensure the apparatus is in its final "SPOT" and is positioned where it can be used most effectively. The Tiller Firefighter can make use of the headsets and the buzzer as a means of communication. Tiller/OSV Firefighters should be in full PPE enroute to the incident to allow them to immediately go to work upon arrival at the incident.

ON SCENE CONSIDERATIONS

The Tiller/OSV Firefighter should first take a ground ladder and attempt to place it in the rear (Charlie side) of the structure. During the trip to the rear, the Tiller/OSV Firefighter should be sizing up the structure. After placing the ground ladder in the rear, the Tiller/OSV Firefighter should return to the truck for a second ladder. During this return trip, the Tiller/OSV Firefighter should complete a 360 of the structure by returning on the opposite side of the house from the first trip. Doing so helps the firefighter obtain a complete size up of the structure. (Note: the 360 performed by ladder company personnel is not done for the same reason as the 360 that was completed by the initial Incident Commander. The initial Incident Commander does a 360 to determine the proper attack mode and tactical considerations, while the Tiller/OSV Firefighter does a 360 to gather information specific to prioritizing ladder company tasks). Several size up factors to consider when doing the 360 could include the following:

- Construction Type—Is this structure residential, commercial, or mixed use? How will the fire spread in this structure, and what type of ventilation will be needed? Is the structure balloon frame, lightweight wood frame, or ordinary construction?
- Basement—Does the structure have a basement? Are there basement windows or exterior access to get into the basement? Is the fire located in the basement?
- Victims—Are there victims hanging out windows or on the ground around the perimeter of the structure?
- Forcible Entry—Exterior doors on the Bravo, Charlie, or Delta sides may need to be forced. If the doors are not easily forced, call for assistance from the second ladder or from the rescue company. Are any windows boarded up or do they have bars on them?
- Utilities—Where are the gas and electric shutoffs located? Determine if the gas needs to be shut off at the meter. Is the gas meter located outside the structure? Look for the location of the weather head in case the drip loops need to be cut.

VENTILATION

After placing a second ladder, and in some cases a third ladder, the Tiller/OSV Firefighter should be prepared to go to the roof with the driver for vertical ventilation as needed. If vertical ventilation is needed, the Tiller/OSV Firefighter should don their SCBA (if not already wearing it) and go to the roof with the driver. Working as a team to perform vertical ventilation will ensure the task is completed quickly and safely. Once natural ventilation is completed, the Tiller/OSV Firefighter should coordinate with the driver to place lights and the PPV fan**. Ensure interior crews have called for the fan to be turned on before starting any PPV fan.** For a basement fire, a box fan to create negative pressure may be a good option.

SALVAGE

Salvage is often one of the last considerations for first due Columbus ladder companies. This is due to salvage being lower on the priority list than tasks such as Forcible Entry, Ground Ladders, and Ventilation. Those tasks often deal with Life Safety and Incident Stabilization, which are a higher priority than Property Conservation. That does not mean Property Conservation is not important, but there is only so much a two person outside team can accomplish in the initial stages of an incident. Another reason Salvage is overlooked is that most firefighters do not practice Salvage like they do Forcible Entry, Ground Ladders, or Ventilation techniques. One of the ways Tiller/OSV Firefighters can assist with Salvage is by placing salvage covers near the entrance of the involved structure. Other ways Tiller/OSV Firefighters can assist with Salvage is by limiting the damage done to the occupant/owner's belongings. It is easy to just start shoveling debris out windows or doors into the yard. However, a professional firefighter will take the extra steps to ensure the occupant/owner's items and belongings are not just thrown out along with any debris and burned materials.

OTHER CONSIDERATIONS

Rehab for the crew of the ladder company is something the Tiller/OSV Firefighter and the Driver can have set up once the fire has been contained. Stocking the water cooler with bottles of cold water and having extra towels and face wipes on the truck will allow the crew to clean up and hydrate. Setting up box fans at the truck and keeping the cab AC on (Or the heat, depending on the season) will give the crew some relief after working. Tiller/OSV Firefighters will be faced with many tasks on an emergency scene that need to be accomplished quickly. Sizing up the structure, prioritizing tasks based on that size up, and executing those tasks will ensure a successful outcome. The Tiller/OSV Firefighter will have to make decisions on their own, without the benefit of their officer being there to guide them. The Tiller/OSV Firefighter should rely on training, experience, and common sense when making decisions. It is essential that Tiller/OSV Firefighters practice their basic firefighter skills to allow them to perform a multitude of tasks quickly, efficiently, and safely while on the scene of an emergency.

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SPOTTING THE TRUCK OVERVIEW

TRUCK OPERATIONS MANUAL

SECTION TOPICS

Spotting the Truck Overview

Basic Review and Terminology

General Run Type Considerations

Arrival Order

On Scene Operations

Defensive Operations

SECTION OBJECTIVES

Understand common terminology pertaining to spotting the truck

Understand where the truck should be positioned for different run types

Understand how to spot the truck for a residential structure 3 stories or less

Understand how to spot the truck for a residential structure 4 stories or more

Understand how to spot the truck for commercial and mixed-use structures

Understand how spotting the truck can change based on the arrival order

Understand how to spot the truck to maneuver around common obstacles

Understand various options for tip placement on tiller ladders

Understand various options for bucket placement on platform ladders

Understand how defensive operations can affect spotting the truck

SPOTTING THE TRUCK

OVERVIEW

- Positioning the truck on a scene is one of the driver's most important tasks
- On most fire scenes, drivers only get one chance to position the truck; they have to be thinking about positioning the truck correctly **every time** they pull up to any incident
- Ladder trucks are the most expensive trucks in the Division because of the aerial ladder mounted to the truck; therefore, make sure the truck is in a position to be used when it is needed
- Positioning the truck correctly on the scene requires knowledge, training, and a lot of practice to be proficient
- This section of the manual will help firefighters become better at understanding how to position CFD ladder trucks on emergency scenes

CONTENTS

BASIC REVIEW AND TERMINOLOGY

INTRODUCTION

- There is some basic terminology that firefighters should know before discussing positioning the trucks
- Below are a few common terms that will be used throughout this manual

OUTRIGGERS

Outriggers go out and down. All CFD ladder trucks have outriggers

JACKS

Jacks just go down; only the platform ladders in CFD have jacks

PEDESTAL

The box on the turntable that firefighters use to operate the aerial ladder

TURNTABLE

Currently, all CFD ladders are midmounted, meaning the turntable is mounted in the middle of the truck

FLIGHT PATH

The path the aerial ladder will take from the bedded position in the cradle to its destination for use on the scene. Raising, rotating, and extending the ladder is all considered part of the flight path

OUTRIGGER STAB/JACK LIGHT

These outrigger stab/jack lights are spotlights on some ladder trucks that show the operator of the ladder exactly where the outrigger foot will land on the ground when the outrigger is fully extended and down

LADDER TIP

The ladder tip is the very end of the fly section of the aerial ladder

SCRUB AREA

The surface area of a building that can be touched by the platform's bucket or the tiller's tip

GENERAL RUN TYPE CONSIDERATIONS

FIRES AND FIRE ALARMS

When positioning ladder trucks on the scene of fires and fire alarms, drivers should position the ladder for rescue or ventilation the majority of the time. If the first arriving company determined immediately upon arrival that it is going to be a defensive fire, then drivers should be positioning their trucks for defensive operations (A transitional attack is not a defensive operation).

GAS LEAKS, SERVICE RUNS, WATER RESPONSES, VEHICLE ACCIDENTS, EMS CALLS

Positioning the trucks on these types of incidents varies a lot. Many times, drivers have the ability to reposition the truck on these types of incidents as necessary. Many of these runs will not require the use of the aerial ladder; sometimes the positioning may be just to provide lighting. Reading the remarks on the MDC and listening to the radio traffic can help the crew think about what tasks might need to be performed upon arrival.

RESIDENTIAL STRUCTURES—THREE STORIES OR LESS

Houses:

Position the ladder for vertical ventilation unless victim rescue using the aerial ladder is needed upon arrival. When positioning the ladder for vertical ventilation, pay attention to the pitch of the roof and the direction of the peak. The aerial is used not only to get firefighters to the roof, but also **to increase firefighters' safety on the roof**. The majority of residential houses in the inner city are three stories or less, with some type of peaked roof. Keep in mind that it is faster to throw a ground ladder to a second story or third story window for victim rescue than it is to set up the truck and move the aerial ladder/bucket to the window.

Multi-Family Residential Structures:

Try to determine what section/area of the building the fire is in; position the ladder close to that area of the building. Try to maximize the scrub area with access to windows on the second and third floors while still ensuring access to the roof for vertical ventilation if needed.

RESIDENTIAL STRUCTURES—FOUR STORIES OR MORE

Houses:
Although houses with four stories or more are not very common in Columbus, some do exist. Firefighters should position the ladder for vertical ventilation; they should also try to ensure they can reach a few of the windows on any story above the third with the aerial ladder.

Multi-Family Structures:
Try to determine what floor and section of the building the fire is in, and position the ladder close to that area of the building. Make sure to position the ladder to maximize the scrub area. Some of these buildings will have floors that are out of the reach of the aerial.

COMMERCIAL AND MIXED-USE STRUCTURES

Since there are so many different types of commercial structures, this manual will only give general guidance for positioning a truck at these types of buildings. Normally, commercial buildings have more options for places to position the truck, because the business needs space for employees or customers to park. This is an advantage because it gives the ladder company space to work around cars and other apparatus. Building construction, the extent of the emergency, and the tasks needing to be performed will guide firefighters on positioning the truck at these types of structures. Many commercial structures will have parapets; the height of these parapets can vary from several inches above the roof line to several feet above. Firefighters should remember that parapets are usually shorter near the edge or rear of the building; spotting the ladder to the roof in those locations will make it easier to transition from the aerial to the roof. CFD platforms have parapet ladders that do a great job of combatting the taller parapets. Some commercial buildings will have different roofs for different parts of the structure, and some of these roofs will have different heights. If it is possible, try to position the ladder where it can be used to access multiple roofs.

ARRIVAL ORDER

FIRST DUE TRUCK POSITIONING

A common saying in the fire service is that “The ladder gets the front of the building.” This does not mean that firefighters should have the mindset that the ladder always needs to park directly in front of the structure. **SOP 02-02-02** states that the first ladder will generally take the front of the structure, **or <u>a position that will be most suitable for the use of the aerial</u>**. On some structures, directly in front of the structure is one of the worst places the truck can be positioned. As firefighters on the first due ladder are pulling up to the scene, they should take the time to slow down and spot the truck for the **best use of the aerial**; they will normally only get one shot at spotting the truck in the best position.

SECOND DUE TRUCK POSITIONING

There are many things the driver of the second due truck should be considering while responding to a fire. One of the main things to consider is the direction the first due ladder will be coming from. A lot of firefighters will try to ensure the second ladder goes to the rear, but sometimes that is not possible due to limited or even no access. In neighborhoods that do have access to the rear, there will often be more obstacles (wires, dumpsters, fences) in the alley than on a main street. The driver of the second ladder must decide if they are going to try to make it to the rear, or if the more suitable position for the aerial is on the primary street. If the decision is made to stay on the primary street, consider approaching the scene from the opposite direction the first ladder came from. Sometimes approaching the scene from the opposite direction will allow the second due truck to be in a better position than the first due truck.

THIRD DUE TRUCK POSITIONING

On most residential fires, the third due ladder company will be RIT and will not have an opportunity to position the truck anywhere close to the actual structure. If the ladder truck can be positioned close enough to the structure to use the aerial, firefighters should ensure they are parking the truck in the most logical position to actually use the aerial device if needed. For instance, can the aerial ladder reach the roof or elevated windows? Position for defensive operations if the fire appears to be getting worse. At larger commercial buildings, especially with members of other companies operating on the roof, the third due truck should be quick to set up the ladder to the roof to give companies working on the roof an additional means of egress.

ON SCENE OPERATIONS

THE APPROACH

From the moment firefighters hear the dispatched address, they should be doing a mental size-up. Many firefighters know what type of structure it will be just from hearing the address. Some things to consider could include the following:

- Is it a commercial building with plenty of space to position the truck?
- Is it a tight residential street where cars are normally parked on both sides of the road?
- Is it a street where all the houses are set back 150 feet from the road?
- Is it a street in an apartment complex with limited access?

These are just a few of the things firefighters should be thinking about. For firefighters who are unfamiliar with the area, their approach size-up will start once they make the turn onto the street where the incident is located.

As the turn onto the street is made, firefighters should start looking at the structure types. Are they single family homes, doubles, or eight family apartment buildings? Or is this a commercial area with only commercial buildings on this street? What are some obstacles that can be seen on the street? Are there data/phone lines that the ladder will have to tuck under? Are there a large number of trees to try to maneuver through? Is this a tight street with parked cars that will make spotting the outriggers more challenging? These are all things firefighters should notice when they turn onto the street the fire is addressed on.

Once the driver identifies which house/building it is, they should start slowing down and decide if they are positioning for ventilation or for rescue. The majority of the time, this decision depends on the type and height of the structure.

OBSTACLES

Obstacles can be on the ground or in the air—trees, cars, powerlines, cable lines, fences, etc. Firefighters must scan for and identify obstacles to determine the best way to get past them. Ground obstacles are normally obstacles for the outriggers. One of the most common obstacles for the outriggers is parked cars, but other obstacles can include sewer drains, curbs, utility covers, etc. Some CFD ladder trucks have cameras, lasers, or spotlights to help firefighters spot the outrigger in-between cars. These are called stab/jack lights.

If there is not enough space for the outriggers to go in between parked cars, drivers may be able to hug the non-working side and short-jack the ladder to create space for the working side jacks.

Obstacles in the air are normally wires or trees. Trees are an obstacle that firefighters can normally work with. Depending on the age and size of the branches, sometimes cutting a few branches will give firefighters the access they need. Try to avoid doing unnecessary damage to trees. Power lines are dangerous and can harm and possibly kill firefighters. Be very careful when working around power lines. Firefighters should never let their bodies or any portion of the ladder or the vehicle come in contact with any wires.

GETTING THE CAB OUT OF THE WAY

Since aerial ladders themselves do not bend, firefighters must have a straight shot from the turntable to the objective. One of the first obstacles firefighters have to overcome is the cab of the truck. Turning the cab of the truck in the opposite direction of the fire will sometimes increase the scrub area.

Nosing into any structure is something that should be avoided. On buildings under three stories, shooting the stick over the cab might not allow for roof access due to the cab being in the way.

TURNTABLE PLACEMENT

Knowing where the turntable is in reference to the vehicle is very important. When sitting in the driver’s seat, the driver should have a mental picture of how far the turntable is behind them. The dual axles on the tillers can be used as a reference, since the turntable sits between them.

When drivers are spotting the truck, they are really positioning the turntable. The location of the turntable determines the scrub area. For example, when attempting to tuck the aerial under wires, the closer the turntable is to the side of the street the wires are on, the higher the tip/bucket will be able to reach on the structure.

CAN I STICK IT FROM HERE?

Once the aerial ladder is within reach of the structure (within 100’) the driver should ask themselves: “If I spot the truck right here, can I stick the roof?”

- If the answer is yes, the driver has to decide if there is a better position ahead if they continue driving forward, or if this the best spot they are going to get
- If the answer is no, the driver has no choice but to continue driving forward
- If the decision is made to continue driving forward, drivers need to constantly ask themselves: “If I stop right here, can I stick it from here?” Once the driver is in a spot where the answer is yes, they must decide if driving forward some more will put the truck in a better or worse position

Once the driver reaches the desired location and is ready to park in that spot, there are a few additional factors that need to be considered:

- Can the outrigger/s fully extend on the working-side?
- Flight path—are there any obstacles in the flight path to the structure?
- Is this the best place to position to be able to work from the aerial/bucket?
- Are there any data/phone lines that the ladder will need to tuck under? If so, is the turntable close enough to the curb?

TIP PLACEMENT ON TILLER LADDERS

Tip placement depends on multiple factors. The type of incident and the task needing to be performed are the two major factors in tip placement. Will firefighters be using the aerial ladder to gain access to a flat commercial roof to investigate an AC unit? Will firefighters be using the aerial ladder on a residential house fire to cut a ventilation hole? Are firefighters using the aerial to help an occupant climb down from a balcony? Those are just a few of the tasks firefighters might be performing with the aerial ladder.

Vertical Ventilation (Peaked Roofs)

Firefighters should try to position the aerial to make it safer for them on the roof. Some ways to accomplish this include firefighters cutting from the stick or with the stick backing them. This should increase firefighters' comfort level on the roof and make roof operations less dangerous.

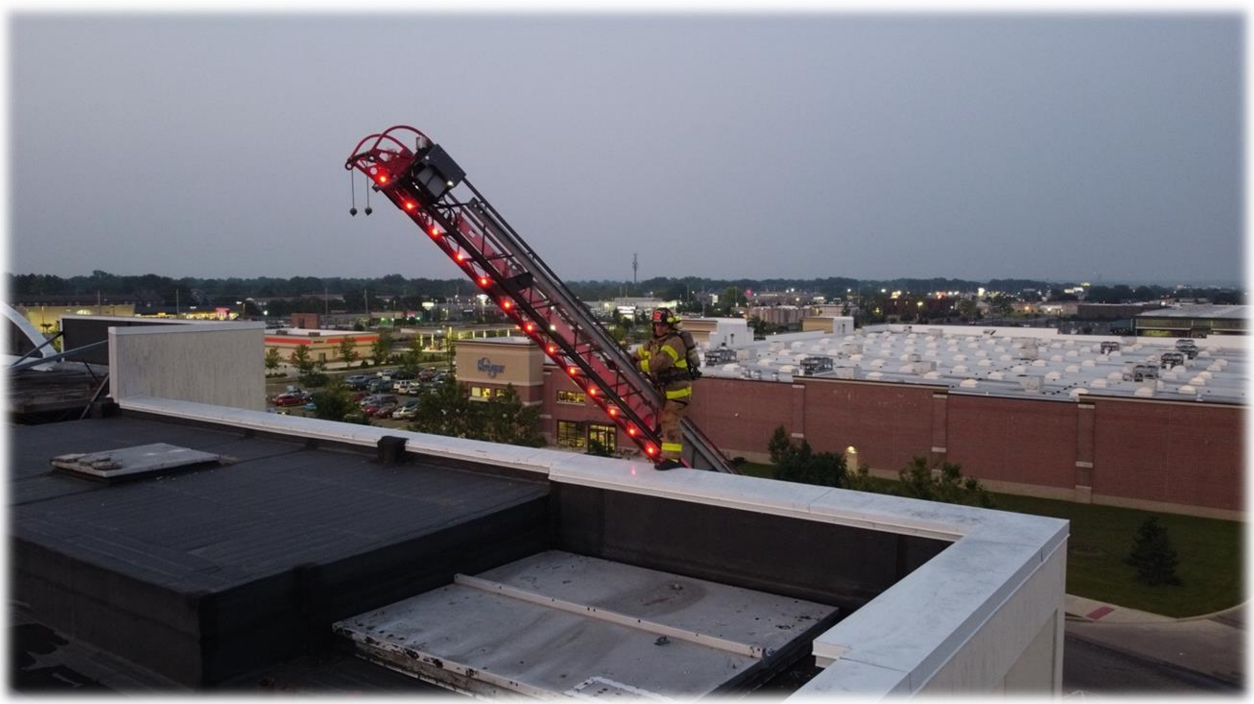
Roof Access (Flat Roofs)

Roof size, building height, parking access, height of parapets, and the incident type will all play a role in tip placement. During a fire, firefighters want to ensure the tip of the ladder is visible for firefighters on the roof, and that mounting and dismounting the ladder is possible for a firefighter in full PPE and SCBA. The next few pages will show three different options for tip placement on flat roofs; each has its advantages and disadvantages.

<u>Tip Level or Slightly Above the Roofline/Parapet</u>:

This is an option for small flat roofs that are not very high, when the aerial is at a lower angle (30° or less). *Disadvantages*—Cannot always see the aerial ladder in a smoky environment because not much of it is showing above the roofline. *Advantages*—Firefighters do not have to climb over the beam of the aerial to dismount from the aerial.

Tip Extended Eight Feet or More Over the Roof Line:
This is an option for larger flat roofs and/or when the aerial is at an angle greater than 30°. *Disadvantages*—Firefighters cannot just walk off the tip to dismount the aerial. *Advantages*—More of the aerial is visible from anywhere on the roof. When mounting and dismounting, firefighters have more of the aerial to grab to assist them during the transition from the roof to the aerial. This is comparable to raising a ground ladder three to five rungs over the roofline.



<u>Squaring the Corning</u>:
This is an option on any flat roof where the truck can be positioned at the corner of the building. It is a very similar concept to the option shown on the previous page, extending the tip eight feet or more. The only difference is the aerial is riding the corner of the building. *Disadvantages*—Requires a significant amount of skill to position the turntable in the correct spot to have the aerial close enough to the side of the building. *Advantages*—Allows the aerial ladder to be seen easily by firefighters working on the roof, and it is easier for firefighters to transition from the aerial to the roof than with the option shown on the previous page.

BUCKET PLACEMENT ON PLATFORM LADDERS

The incident type, the task needing to be performed, and the amount of space available are the three major factors in bucket placement. Are firefighters using the bucket just to gain access to the roof? Are they using the bucket on a house fire to cut a vent hole? Or are firefighters using the bucket to rescue an unconscious victim from a window on the fourth floor of an apartment building? These are just a few of the different tasks firefighters could be using the bucket for.

Vertical Ventilation (Peaked Roofs):
Firefighters should try to position the bucket to make it possible to cut from the bucket or with the bucket behind them.

Roof Access (Flat Roofs):
Position the bucket to make it easy to get in and out of the bucket. Use the parapet ladder if needed.

POSITIONING FOR VICTIM RESCUE

When approaching a victim with an aerial ladder/platform, approach from above if possible. If the approach is made from below, the victim may try to jump onto the aerial.

Tiller Victim Rescue:

Tip placement for a victim rescue can change significantly depending on the situation; use common sense. If the victim is conscious, try to place the tip in a location that allows the victim to easily transition from their location (window, balcony, roof) to the tip of the aerial. Keep in mind that for most people this is the first time they have ever been on an aerial ladder; try to give them very simple but direct instructions, while also focusing on keeping them calm.

Platform Victim Rescue:

Try to square up the bucket with the objective. Try to get as close as possible to the victim's location to ensure there is very little space between the bucket and the building. Talk to the victim to try to keep him/her calm. If the victim is unconscious, it may be easier to position the floor of the bucket a few inches below the window or balcony.

DEFENSIVE OPERATIONS

OVERVIEW

Positioning the ladder for defensive operations is more than just stopping somewhere near the structure and putting the stick/bucket 100 feet in the air. A defensive fire is either a defensive operation upon arrival, or a transition to a defensive operation from an offensive attack. All CFD ladders have master streams capable of flowing over 1,000 gpm.

OFFENSIVE TO DEFENSIVE

If firefighters did their job and positioned their truck correctly when they arrived on the scene initially, switching from an offensive mode to a defensive mode should be relatively easy. For tiller ladders, firefighters will have to retract the aerial, place the nozzle in the waterway position, and secure an engine to handle water supply. Platforms will just need to secure a water supply. If the officer or crew have any concerns about the ladder truck being parked too close to the structure, never be afraid to reposition the truck.

DEFENSIVE ON ARRIVAL

When arriving on the scene of a fire that is going to be a defensive operation, the driver should be thinking about multiple different factors:

- Can the ladder truck stay out of the collapse zone and still be effective? The collapse zone is 1 ½ times the height of the building
- Can the ladder truck be positioned on a corner and still be effective? Positioning on a corner should provide some protection if the walls of the building were to collapse
- Are there any doors or windows where the nozzle could be pointed in at an upward angle to flow water into the structure from underneath the roof? Has the fire burned through the roof yet?
    - Firefighters must find a way to flow water from their master streams onto the actual burning material
    - If the fire has not burned through the roof, firefighters should be attempting to position somewhere that they can flow water into the structure from beneath the roof (through doors, windows, soffits, or gable ends)
- Where is the fire and what direction is it traveling? If possible, try to position the truck where it will provide access to both the involved and uninvolved portions of the building. This will allow firefighters to try to also protect the unburned portion of the building
- Is the truck far enough from the fire that it will not be damaged by the heat? A defensive fire is not worth damaging CFD apparatus. Never be afraid to apply water to the truck itself to buy some time if the truck needs to be moved
- Ensure that the truck is not positioned under any power lines that could come down

LADDERING THE STRUCTURE OVERVIEW

TRUCK OPERATIONS MANUAL

SECTION TOPICS

Laddering the Structure Overview

Setting the Truck Up for Success

Before the Emergency

On the Scene

SECTION OBJECTIVES

Understand how to inspect a ground ladder during morning checks

Understand the priorities for ground ladder placement

Understand the pros and cons of open vs. closed halyard systems

Understand how to place a ground ladder for rescue

Understand how to set the truck up for easy ground ladder deployment

Understand how to place a ground ladder for ventilation

LADDERING THE STRUCTURE

OVERVIEW

- Ground ladder placement requires ladder company firefighters to rapidly evaluate the need for and priority of ground ladder placement
- Ladder company firefighters who practice raising, positioning, estimating heights, and knowing the reach of ground ladders will be the most successful
- Ground ladders are used by Columbus Firefighters for a variety of tasks:
    - Gaining access above ground, and in some cases below grade, to perform tasks
    - Providing multiple points of egress from areas where the normal means of egress are compromised
    - Provide a stable working platform to perform tasks such as vertical ventilation from a roof ladder or overhauling soffit from an extension ladder on a 2-story structure

CONTENTS

- Before the Emergency
- Setting the Truck Up for Success
- On the Scene

BEFORE THE EMERGENCY

MORNING CHECKS

- Ground ladders should be inspected daily during morning checks
- Visually inspect for obvious damage to beams, rungs, or halyards to identify any immediate issues requiring the ladder to be repaired or replaced
- Closely inspect the heat sensor label and look for any deformities or discoloration that would indicate exposure to high heat. The ladder in the photo to the right was exposed to high heat and melted during a multiple alarm fire. Note the charring and discoloration
- Tools and Equipment has a spool of natural rope they will cut to the specific length for extension ladder halyards
- Station Level Maintenance that can be performed by on company personnel consists of halyard replacement, general cleaning, and lubrication
- Any other defects or damage to ground ladders will require Tools and Equipment to repair or replace the ladder
- If unsure whether a ground ladder should be taken out of service during a daily inspection, contact Tools and Equipment for guidance
- An important consideration when putting a new ground ladder into service is making sure the halyard is tied properly
    - When delivered from Duo Safety, halyards come tied so the fly section will not move during transport from the factory to Tools and Equipment. If the ladder is placed into service without inspecting the halyard, personnel will first have to untie the halyard to extend the ladder

OPEN VS CLOSED HALYARDS

- Halyards can be set up two different ways on CFD ground ladders
- One way is the **open system**—the halyard is tied to the bottom rung of the bed section, then goes up over the pulley with the remaining slack hanging down to be tied off
    - This slack can be tied off using a clove hitch and overhand safety
    - In theory, if the dogs and pawls assemblies fail, this halyard slack being tied off will be an extra safety to keep the fly section from moving
- The second way is the **closed system**—the running or chasing halyard tie
    - In this system, the halyard slack comes down from the pulley and is tied to the bottom rung of the fly section, versus the bottom rung of the bed section
    - No slack in the halyard needs to be tied off; the disadvantage is not having a safety if the dogs and pawls fail
- The ladder on the left side of the photo shows an open system. The halyard is secured to the bottom rung of the fly section, then goes up and around the pulley to the bottom rung of the bed section
- The ladder on the right shows a closed system. The halyard is secured to the bottom rung of the fly section, and goes up and around the pulley. It then goes around the bottom of the bed section back to the fly section, creating a continuous loop
- The ladder on the left side of the photo shows an open system with left over slack from the halyard after the ladder has been extended into position. The ladder on the right shows the closed system halyard being looped back around the bed section with no slack, then going back up to be resecured to the fly section above

PROS AND CONS

- Through training and experience regarding halyard setup, it has been discovered that it is extremely unlikely for both dogs and pawls to fail, since they are on separate beams
- In addition, recruit and apprentice firefighters are taught to visually inspect the dogs and pawls before transitioning from the bed section to the fly section while climbing. This is a verbalization that must be performed during testing for recruits and apprentices
- A closed halyard system is an advantage to companies on the street—it keeps the halyard from interfering with fire ground operations and it does not need to be tied off like an open halyard system does

SETTING THE TRUCK UP FOR SUCCESS

PREPARING THE GROUND LADDERS

Ensure the ladder lengths are clearly marked. This will help newer firefighters easily identify the lengths of the ladders at an emergency scene, which will decrease the time it takes to remove the ladders from the truck.

Ensure that all the ground ladders come off the truck the same way—fly section on the left or the fly section on the right, whichever is preferred. Doing this will help firefighters not to have to think during the emergency. By setting the ladders up this way, firefighters will not have to process what side of the ladder they need to be on when they pull the ladder out.

Ensure that each ladder has its balance point marked. This will keep firefighters from having to guess where the balance point is on the ladder. When marking the balance point, ensure the marking is from rung to rung on the beams on both sides of the ladder. Firefighters should be able to clearly see the balance point while pulling the ladder off the truck.

CHECKING THE HALYARDS

Ensure the halyard is not too long or too short. The photo on the left shows an appropriate amount of slack in the halyard. A halyard that is too short will make raising the fly section difficult because there will not be enough slack in the halyard to make a handle when pulling with the halyard. It may also make it hard to get the ladder to lock into the bedded position. A halyard that is too long will create a trip hazard when firefighters are carrying the ladder. A halyard that is too long can also get caught in the chute where the ladder is stored and hinder it from sliding out.

PIKE POLES ON THE LADDERS

If there are pike poles strapped to the ladders, make sure the pike poles are mounted closer to the butt of the ladder where they can be reached and maneuvered with the ladder stored in the truck. If the pike poles are mounted too far away from the butt of the ladder, they could fall off the ladder and make it difficult to pull the ladder out of the storage chute.

ON THE SCENE

LADDER OBJECTIVES

- At a Working Fire in Columbus, the first ladder company on scene, and possibly the second ladder company, will place ground ladders to upper story windows
- The ***primary objective*** for ground ladder placement to windows is to provide egress for interior companies
- Although the primary objective of the initial ground ladder placement is to provide egress for interior crews, the ladders can also be used to give interior search teams an initial entrance to the structure via an upper story window
- Depending on the structure's height and the ventilation needs, ground ladders may be placed to provide immediate access to the roof for vertical ventilation

COVERING THE STRUCTURE

- Firegrounds in which no victims are present at windows should still have ground ladders placed; this provides interior crews with a means of entry and egress. Ideally, first arriving ladder companies should strive to place ground ladders on all four sides of the structure
- Ladder crews divide the task of ground ladder placement between the driver and the Tiller/OSV firefighter. Second and third arriving ladder crews can assist with ground ladder placement based on the size of the structure and how many ladders are still needed

- The four sides rule mainly applies to residential single and double family residences. A long, center hallway, multi-family apartment building would not necessarily need all four sides laddered. If the long sides with windows are the Bravo and Delta sides, ladders could be focused on the area nearest the fire and the apartment(s) adjacent to the fire on either side and across from the fire unit
- Commercial structures may have very few windows, but they may need initial ladders placed for roof access

RESCUE POSITION

- The importance of proper ground ladder placement at an upper story window, in what is known as the **Rescue Position**, cannot be emphasized enough
- **Rescue Position**—the ladder is placed at an approximately 70°-75° climbing angle with the tip of the ladder below the windowsill. This keeps the tip of the ladder's fly section, and any rungs, from hindering a firefighter from rapidly escaping through that window
- If an unconscious victim is being removed out a window onto a ladder(s), any protrusion of the ladder tip into the window will be an obstacle in an already intense situation

RESCUE PRIORITIES

- Placement of ground ladders on fire scenes should be prioritized based on the conditions present
- According to **SOP 01-03-20 Rescue Factors**, the priority for victims needing to be rescued is as follows:
    - The most severely threatened
    - The largest number of victims
    - The remainder of the fire area
    - Exposures
- If occupants of the fire building are hanging out of upper story windows upon arrival, ground ladders will be the quickest means to remove them
- Obviously, this will be for victims within reachable heights of ground ladders. Engine companies operating out of stations without a ladder company need to consider using the 24' or 14' ladders carried on their engine for victim rescue
- If the victims cannot be reached with either of those ladders, the engine company officer needs to communicate that as an urgent message to the first arriving ladder. The first ladder can then prioritize that victim using longer ground ladders or the aerial ladder

VENTILATION POSITION

- At times, an upper story window may need to be ventilated when the only access is via a ground ladder
- **Ventilation Position**—the ladder is placed on the windward side of the window at a 70°-75° angle with the tip of the ladder even with the top of the window. This allows the venting firefighter to break and clear the window with the byproducts of combustion ventilating away from them

FLY IN OR FLY OUT?

- Duo Safety's owner's manual recommends that all extension ladders be positioned with the fly out
- Duo Safety states that their extension ladders are 4% stronger with the fly section out and the bed section toward the building
- Although the 4% strength difference should be considered important, something more critical than that is the potential hang up that a ladder with the fly in can pose for a firefighter performing a ladder bailout maneuver
- In Saving Our Own, firefighters are taught to position themselves on the ladder and slide the beams when a rapid descent is necessary
- During a ladder bailout and descent, a firefighter can be stopped or even stuck at the fly section to bed section transition if the fly is not out
- Since firefighters never know when a bailout situation will occur, the ladders should always be properly positioned to prevent this unnecessary situation from happening
- A simple rotation of the ladder can be done while booming the ladder into the building, or immediately after the tip is against the structure

The ladder on the left is in the fly in position. Note the extra catch that is created at the transition from the fly section to the bed section

The ladder on the right is in the fly out position. Notice how the fly section smoothly drops to the bed section to limit the possibility of a firefighter getting caught on it

The photo above shows the firefighter sliding down the fly section and getting caught on the bed section after bailing out of the structure with the ladder in the fly in position

This photo highlights the step out that is created when the ladder is in the fly in position, vs. the step in when the ladder is in the fly out position

THINKING OUTSIDE THE BOX

- It is important to understand that when tasked with laddering the structure with ground ladders, every building is not surrounded by perfectly flat ground and grass
- Firefighters should be able to quickly think outside the box and use the objects and terrain around them to help them position the ladders
- For example, when laddering a building surrounded by concrete, the ladder could be butted up against a parking block, dumpster, etc.
- Just because the angle of the ladder is not perfect does not mean that it is unusable. Firefighters should use the tools around them and use critical thinking to overcome the obstacles that present themselves on scene

The photo to the left shows how crews used an extension ladder to access a porch roof. From there, they used a roof ladder to reach the upper floor windows. Because the angle was less than ideal, they deployed the hooks on the roof ladder and hooked them into the window. This allowed crews to safely use the ladder without fear of it slipping out from under them.

Tri-levels create a unique challenge for outside teams laddering the structure. Frequently, they are missed on scenes because the standard complement of ladders can be awkward for their height. In this photo, crews worked together to foot the ladder at a lower angle so the second floor could be accessed. If possible, all ladders should be footed. However, it is very important to foot ladders that are thrown at a low angle.

The ladders in the photo to the left were footed up against the adjacent structure to keep them from sliding. One of the ladders is placed up against the concrete walkway, and the other ladder is against the access stairs for the adjacent building.

On certain pitched residential roofs like the one shown in the photo to the right, ground ladders can be fully extended and placed onto the roof from the ground. Although the angle is less than normal, it allows firefighters to cut from the extension ladder just like they would from a roof ladder for vertical ventilation.

FORCIBLE ENTRY OVERVIEW

TRUCK OPERATIONS MANUAL

SECTION TOPICS

- **Forcible Entry Overview**
- **Conventional Forcible Entry**
- **Initial Size-Up**
- **Sizing Up an Individual Door**
- **Forcible Entry Tools**
- **Circular Saws**
- **Methods of Forcible Entry**
- **Residential Doors—Single Firefighter**
- **Padlocks**
- **Security Bars and Storm Doors**
- **Garage Doors**
- **Commercial Roll-Up Doors**
- **Block Walls**
- **Other Forcible Entry Considerations**
- **Take Pride in Your Craft**

SECTION OBJECTIVES

- Understand how to size up a building specifically for forcible entry
- Understand how to size up an individual door for forcible entry
- Understand the purpose of each forcible entry tool
- Understand the various circular saw blades and their uses
- Understand inboard vs. outboard circular saw orientation
- Understand how to use the irons for inward and outward swinging doors
- Understand how to force residential doors with a single firefighter
- Understand how to identify and defeat common types of padlocks
- Understand how to defeat security bars on windows
- Understand how to cut garage doors with a circular saw
- Understand how to identify and defeat common commercial roll up doors
- Understand methods for breaching block walls

FORCIBLE ENTRY

OVERVIEW

This section of the manual will cover various forcible entry tools and techniques. Some of the techniques and tools covered will be a review of what is taught at the recruit level, and other techniques will expand on those topics to provide additional training for apprentice firefighters. This section is not intended to be a comprehensive guide to forcible entry or to limit forcible entry techniques to those shown in this manual. As always, crews should seek out and preplan potential hazards/obstacles in their response area and come up with a plan for overcoming them.

CONTENTS

- Conventional Forcible Entry
- Initial Size-Up
- Sizing Up an Individual Door
- Forcible Entry Tools
- Circular Saws
- Methods of Forcible Entry
- Residential Doors—Single Firefighter
- Padlocks
- Window Security Bars
- Garage Doors
- Commercial Roll-Up Doors
- Block Walls
- Other Forcible Entry Considerations

Forcible Entry challenges change as residents and business owners evolve in their creativity. Firefighters should take advantage of EMS runs, building inspections, and fire alarms to see what forcible entry challenges are present in their districts.

CONVENTIONAL FORCIBLE ENTRY

OVERVIEW

Conventional forcible entry is a hallmark skill for firefighters, especially those assigned to a ladder company. Forcible entry can be defined as the following: ***"Rapid entry into a structure by the use of force to save life and property."*** Examples of incidents requiring forcible entry could include fires, gas leaks, and high priority EMS runs, but the reality is that the need for forcible entry can arise on any incident. Regardless of the obstacles encountered, it is each firefighter's job to overcome them. Although using conventional forcible entry can be a low frequency event, professional firefighters need to be aware of the various obstacles they may encounter in their response areas. As firefighters become aware of these obstacles, they should have a plan for how to complete forcible entry when the situation presents itself. The more proficient firefighters are at this crucial skill, the faster crews will be able to contain the situation.

Forcible entry differs from through-the-lock techniques in that firefighters need to enter **NOW.** The problem behind the door is of more importance and value than the obstacle firefighters intend to force. Saving the homeowner $100 in door repairs does not help if the small kitchen fire grows beyond the kitchen and expands into the rest of the structure. The techniques and information provided in this section are intended for all firefighters, regardless of their assigned apparatus. Nearly every CFD apparatus carries forcible entry tools. First due companies should not have to wait on a ladder or rescue company to force entry if they are not yet on scene. It is each firefighter's duty to gain access as quickly as possible to save life and property.

In the training academy, firefighters learn the fundamental techniques associated with forcible entry. This section will build on that knowledge. Size-up, tool selection, techniques, and other considerations will be reviewed. Not all tools, techniques, and obstacles can be covered fully in this section. It is up to all firefighters to review the challenges in their districts and be prepared accordingly. As these tools and techniques are being described and demonstrated, think about how they can apply to buildings in your run district. Discuss these techniques with senior firefighters at the station; they may have a different technique not listed in this section. Lastly, each firefighter must know where these tools are on their apparatus and how to ensure they are in good working condition.

INITIAL SIZE-UP

OVERVIEW

Just like any other task on the fire ground, a professional firefighter should perform a mental size-up when preparing to force a door or object. Size-up is something that can and should be done well before the fire tones go off at three in the morning. Knowing fire prevention, building construction, your first due district, training, staffing, and observing the structure/conditions while pulling up on scene are all basic components of successful forcible entry. Fast entry is critical for saving lives and property. Some things to consider during a forcible entry size-up are explained in more detail below.

BUILDING CONSTRUCTION

While pulling up at the scene of the incident, looking at the building construction can give crews some indication about what types of obstacles may lay ahead. Commercial and residential occupancies will often require the implementation of different tools and tactics. Preplanning the district can help firefighters become more familiar with the common obstacles found in their district.

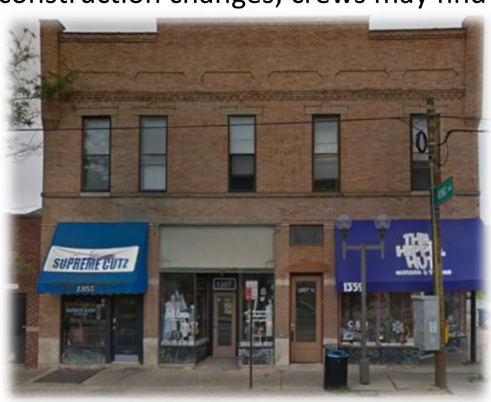
When looking at the pictures above, what type of doors and other security features might firefighters expect based on the building construction and the occupancy designation? Does the fire being a defensive operation (picture on the left) versus an offensive operation change firefighters thought process and tool considerations?

LOCATION OF ENTRY AND PRIORITIZATION

Showing up with initial companies involves a lot of moving parts. Each company may have a different task while attempting to work in unison with one another. Part of the ladder company's job will often be to force entry to provide access for the initial attack line to get to the fire. However, if there are known victims trapped behind a window, door, or other security feature, the priority may shift to life safety and rescue of the trapped individual. By doing a proper size-up, firefighters can recognize where the highest need is, enter there first, and work from there. When multiple obstacles need to be forced (metal bars, rear door and front door, garage, etc.), firefighters must be able to **prioritize** based upon the incident's needs.

On a late night in March 2020, a report of a fire on East Main Street is dispatched, with multiple calls reported. Engine 23 arrived first on the scene of a one-story motel with heavy fire showing. As the engine crew began advancing the line, the Engine 23 officer did a limited 360 and noticed a woman trapped in the fire apartment behind a small metal awning type of window. Her door was shut and conditions were deteriorating. The officer radioed to Ladder 23 that there was a victim trapped in the rear. With the motel door locked and barricaded by the very woman now trapped, it was up to the engine crew to force the door, enter, and contain the fire. Meanwhile, the ladder company worked on forcing the window, victim removal, and ventilation. Be ready to adapt to changing conditions and priorities on the fire ground.

Taxpayers have multiple doors when viewed from the street; determining which door is the priority may be difficult (photos below). This can be compounded by multiple void spaces and construction changes; crews may find it difficult to locate the fire and stairs in these structures.



STAFFING

In addition to the type of occupancy and the entry location, firefighters should consider if they will be working alone or with a crew. Firefighters on the outside ladder team will often be accomplishing fireground tasks by themselves. Tool selection could change if firefighters are anticipating forcing obstacles as a single firefighter.

SIZING UP AN INDIVIDUAL DOOR

OVERVIEW

Forcible entry can be as simple as battling the creativeness of the occupant. As firefighters learn their district, they should take note of potential obstacles that lie ahead. In the Training Academy, the focus is often on using the irons; however, there is an additional arsenal of tools stored on Ladders, Rescues, and Engines. Firefighters should use these tools to their advantage when making quick points of entry or egress. Heavily fortified doors will potentially need gas-powered or hydraulic tools to gain entry quickly. Watch the videos below of Retired Lt. J.D. Vasbinder discussing how to size up an individual door.

Click here to view Commercial Door Size-Up Video 1

Click here to view Commercial Door Size-Up Video 2

DOOR TYPE AND FRAMING

Residential

Door type can be a quick indicator of how difficult gaining entry to the structure will be. Exterior doors on residential structures can be made of various materials:

- Wood
- Vinyl
- Steel
- Fiberglass

Wood framing is very common on exterior residential doors, and it is generally forced more readily by conventional methods.

Commercial

Commercial doors may vary greatly in design and construction. The metal door in a metal frame (metal on metal) door is commonly encountered. These types of doors will generally require greater amounts of energy when being forced by conventional means. These doors are often encountered in less frequently used doorways on commercial structures. Crews may want to consider the use of power tools rather than conventional forcible entry. Another door type is aluminum frame glass doors, which are more common at main entry ways on various storefronts.

Hinges

Hinges are one of the first things a firefighter preparing to force the door can look at to know which way the door will open. If the hinges are visible, the door opens toward you. If the hinges are not visible, the door opens away from you. Knowing this is important to ensure firefighters are maximizing the mechanical advantage of their tools, especially when forcing using conventional methods.

No Hinges Showing

Visible Hinges

Locks

The types of locking mechanisms that responding companies can encounter in their response district will vary greatly from building to building, and even from door to door within the building itself. When performing forcible entry, firefighters may not necessarily need to identify the specific lock they are dealing with, especially in an emergent scenario, only that they need to defeat it. However, many times crews may encounter a lock during a less emergent scenario, and crews may choose to employ *through-the-lock* techniques, which are much less destructive. Below are some common locks that may be encountered; by no means is this an all-inclusive list.

Knob Lock

Lever Handle Lock

Jimmy Proof/Rim Lock or Vertical Deadbolt

Mortise Lock

Deadbolt

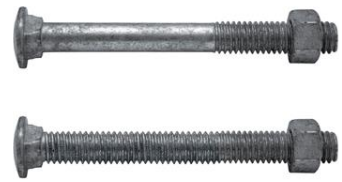
Handle Set Lock

Additional Hardware

In addition to common door hardware, personnel may encounter numerous secondary locking and security devices. As mentioned previously, the types of devices that may be encountered is almost unlimited due to the creativity of businesses and homeowners. Some examples of these additional hardware features are shown below.

Carriage Bolts

One of the most common indicators of additional security devices on a door is visible flat/round bolt heads on the exterior of a door; this is generally indicative of a carriage bolt. Carriage bolts indicate to the firefighter that there are likely additional locks installed on the other side of the door. Conventional entry should still be attempted. By paying attention to these bolts and their patterns, firefighters can anticipate the need to change their approach if these additional locks become a hindrance.



A carriage bolt (also called coach bolt or round-head square-neck bolt) is a form of [bolt](#) used to fasten metal to metal or metal to wood. The round head is intended to allow the bolt to fasten, but only be removable from one side.

Drop Bars

A set of vertical/stacked bolt heads parallel to each other on the outside of the door is generally indicative of a drop bar (red circles in photo above). Single bolt heads parallel to one another may be another variation of security bar as shown in the second photo on the right. Other variations may include bolts in a triangle shaped pattern, or four bolts in a square pattern.

Sliding Bolts

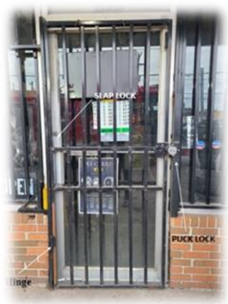
The bolt pattern to the right shows a tight bolt pattern of four bolts that are close to the door edge. There is no pattern mirroring this on the other side of the door. This pattern is a strong indicator of a possible sliding bolt installed on the door and jamb. This pattern could also indicate a padlock hasp has been installed.

Latch Guard

A latch guard is another common piece of hardware found on doors. It is a simple metal plate intended to prevent access/tampering with the door's latch. These are most frequently encountered on commercial occupancies, but they are becoming more common on multi-family buildings such as the one in the first photo on the right.

Security Gate

Security gates are found on many commercial storefronts as added protection from thieves. They can be a simple swinging gate with hinges (first photo on the right), or they are often the folding/scissors style that covers a larger area (second photo on the right). These are often secured with a type of padlock, chain, or a combination of the two.



Security Bars

Security bars come in various designs and materials. They will generally be found on the first floor of businesses and residential structures to protect windows from being used as an entry point into the structure. These bars can also prevent crews from exiting the structure in an emergency situation. Bars should be removed by outside crews, specifically during structure fires.

Padlocks

Padlocks are found wherever the occupant can think of placing them. They are becoming increasingly more durable with case hardening and other design features that put them beyond the traditional bolt cutter forcible entry method. Puck locks are becoming more common because they hide the shackle to protect it from being cut with bolt cutters (first photo on the right).

FORCIBLE ENTRY TOOLS

OVERVIEW

Like many things in the fire service, there are multiple ways to accomplish the same task. When it comes to conventional forcible entry, this still holds true. However, remembering some fundamental tools and methods can help guide firefighters at 0300 with fire showing and victims trapped. Remember, do not get tunnel vision, and use common sense. Try opening the door before using any conventional entry tactic. If not, revert to your forcible entry knowledge.

The tools and equipment shown in this section are found on nearly all Columbus Division of Fire apparatus. It is important to know what your fellow firefighters are planning on carrying during your shift. This is crucial to ensure that when firefighters arrive at the front door of a structure fire, their tools will complement each other and not hinder their effectiveness. Most companies have tools assigned with certain seating positions on the apparatus. For example, the firefighter behind the officer will carry a striking tool (flat head, sledgehammer) to complement the officer's Halligan tool.

If the standard tool complement needs to change from what was discussed earlier in order to match the incident, it should not be assumed that the other members will recognize this need. This may not be the case for more experienced crews that work together frequently; however, if in doubt, communicate and grab the right tool accordingly. If firefighters are unsure of what tools to carry, they should talk to their officers and senior crew members for guidance.

HALLIGAN TOOL

Perhaps the most versatile tool in the fire service, the Halligan tool is the tool of choice for forcible entry. Each officer generally carries a Halligan. When forcing doors, the officer's Halligan pairs well with a striking tool carried by another firefighter. Columbus has a variety of manufacturers of Halligan tools; the most common Halligan is the Pro-Bar.

Pro-Bar

- Overall Length—30"
- Weight—10 lbs
- Adz Length—6"
- Adz Width—2"
- Forks Length—6"
- Crotch Length—5"
- Pike Length—6"
- Material—Single solid piece of drop forged metal

Maximus Rex Bar

- Overall Length—30"
- Weight—8.5 lbs
- Adz Length—6"
- Adz Width—2.75"
- Forks Length—6"
- Crotch Length—5"
- Pike Length—6"
- Material—Single solid piece of drop forged metal

The Maximus Rex Bar has a modified adz with a "Rex" tool built into it. This modification can be used to pull residential and commercial Key-in-Knob lock cylinders for through the lock techniques. This allows the Maximus Rex Halligan to be used similar to a K-tool; however, it will generally not be as effective at pulling locks as a true K-tool.

The "Rex" tool shown in the photo on the right

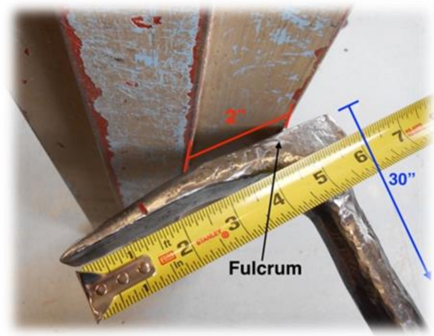
THE NUMBERS BEHIND THE HALLIGAN

The irons are used in a specific fashion for specific reasons. By using the tool the correct way when forcing doors, firefighters can harness the full benefits of its leveraging power. The Pro-Bar is shown as an example below to demonstrate each part's leveraging power.

Outward Swinging Doors

Gapping the door with the adz (2" wide) provides a **15:1** mechanical advantage:

- 30" Pro-Bar length/2" adz
- 100 lbs exerted up or down on the forks end will translate to roughly 1,500 lbs of gapping force with the adz at the door



After gapping, driving, and setting the adz (roughly 2"-4" of depth), the door frame edge will become the fulcrum point. The 2" mark is at the door and the 4" mark is at the frame (fulcrum). Having 2" of usable force (the fulcrum is 2" from the door, which is the load being moved) there is again a mechanical advantage of **15:1**

Inward Swinging Doors

Gapping the door using the adz provides a 15:1 mechanical advantage, the same amount as when performed on an outward swinging door:

- Many residential doors can be forced by this alone
- After gapping the door with the adz, drive the forks to the end of the crotch mark

At this point, the 3'' mark is at the door frame and the 5'' mark is at the jamb. This gives 2" of fulcrum length. The remaining Halligan length is 27", which provides a mechanical advantage of roughly **27:2 (13.5:1).**

- This depth should allow the forks to grab the back of the door frame
- Driving the forks beyond this point will only shorten the Halligan length, leading to decreased mechanical advantage

FLATHEAD AXE

- Length—30” to 36”
- Head weight—6 to 8 lbs
- Material—steel head with fiberglass or wood handle
- Functions—striking, capturing progress when gapping, axe, door chock

DENVER TOOL

- Head weight—6.5 to 8.5 lbs
- Material—fiberglass yellow handles with high carbon treated steel ends
- Functions—prying, pike pole, axe, sledge hammer, battering ram

SLEDGEHAMMER

- Length—30” to 36”
- Head weight—8, 10, 12, or 16 lbs
- Material—typically a fiberglass handle
- Functions—striking, battering ram

HYDRA-RAM II

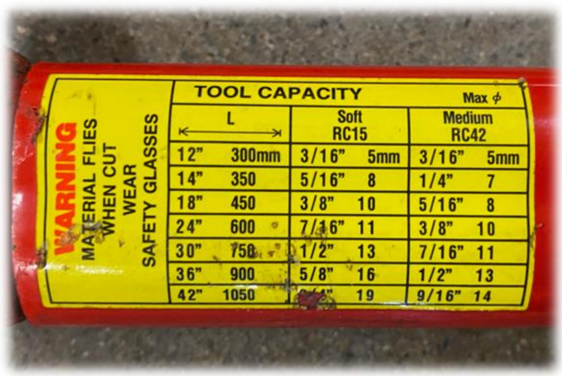
- Spreading distance—6”
- Spreading power—10,000 lbs of force
- Purchase point required—less than 1/4”
- Functions—forcing inward swinging doors, or crushing outward swinging doors to expose the locking mechanism

RABBIT TOOL

- Spreading distance—4”
- Spreading power—8,000 lbs
- Purchase point required—¼”
- Functions—forcing interior swinging doors, or crushing outward swinging doors to expose the locking mechanism

BOLT CUTTERS

Bolt cutters are effective for cutting fencing, light or medium gauge chain, and soft metals. More and more padlocks are made with case hardened metal, which may be defeated by larger bolt cutters using significant force. Repeated use can cause denting or chipping of the teeth, leading to reduced effectiveness or breaking over time.



WEDGE

The wedge is not to be underestimated. In addition to door control, wedges are a great tool for forcible entry. A single firefighter can utilize metal or wood wedges to force doors. Driving wedges into an outward or inward swinging door can create gaps for tools. When making a wedge, keep a narrower angle. This allows for an easier drive into a jam, but it still can be used to effectively chock a door. Additionally, ensure the wood grain runs parallel with the shape of the wedge; this will increase its strength.

NY HOOK

- Length—4 to 6 feet
- Material—steel
- Functions—prying, striking, pulling material (ex. drywall), chisel end
- Steel hooks are preferred over fiberglass hooks because steel hooks are more durable

BATTERING RAMS

- Length—30”
- Weight—40 lbs
- Material—steel

Buckeye Buster

Some ladders and rescues carry an older style ram, pictured on the far right and below

- This style is heavier (80 lbs), but it is very effective for breaching block walls
- Has either a “battering” style flat end or a pointed end for smaller quicker openings
- Requires two firefighters for effective use
- To protect their hands, firefighters should only grip the inside handles during use

The photo on the right shows delivery of the battering ram fondly called the “BUCKEYE BUSTER.” FF Steve Siegwardt and his father Ralph Siegwardt are pictured. Ralph Siegwardt worked for Buckeye Steel at the time, and he worked through his lunch breaks using select scrap steel to create the 80 lb battering ram.

K-TOOL

Although generally not used at active scenes such as working fires, the K-tool is a good option for *through-the-lock* considerations when less destructive methods of forcible entry are desired. The K-tool can be an effective option for locks commonly found on commercial store fronts, such as mortise or rim lock cylinders. The K-tool is generally used with the irons. A striking tool is used to set the K-tool onto the lock; the cylinder is then pulled using the adz of the Halligan. This can be a good option to consider for alarm activations when access is needed and there is no key holder en-route.

[Click here to view the original K-tool Manual]

The K-tool is placed above the lock and driven down until the blades of the tool grab onto the lock cylinder. Once the K-tool has locked onto the cylinder, the adz can be inserted into the loop on the back of the K-tool. When applying force to the Halligan, ensure it is in the same direction the K-tool was applied. For example, if the K-tool was applied from the top down, rotate the Halligan in a downward motion.

This motion should allow the teeth of the K-tool to pull the lock cylinder from the door. At this point crews can insert the key tool into the cylinder space and operate the lock bolt to move it into the open position. This page is just a general overview of the K-tool; successful operation will require skill, practice, and an understanding of different lock types.

EXTRICATION TOOLS

Genesis extrication tools can be used on heavy commercial doors. Since more ladder companies are carrying extrication tools, they are becoming more readily available on scenes. Battery powered tools allow for rapid deployment and portability.

CUTTING TORCHES

In addition to using the tools that are normally found on ladder companies, firefighters can consider using the cutting torches found on rescue companies. Rescue companies carry a variety of cutting torches that require specialized training. Although these cutting torches are generally not the go-to method for forcible entry operations, they could be considered when conventional methods have failed on extremely fortified doors.

CIRCULAR SAWS

A BRIEF HISTORY OF CIRCULAR SAWS IN CFD

It may be hard to imagine that circular saws were not always a standard piece of equipment on CFD fire apparatus. Like many other things in the fire service, much is owed to the firefighters who came before us. In June of 1994, Captain Greg Lash went before City Council to pass emergency legislation to purchase 46 saws for CFD Ladder and Rescue companies. This was done after growing concerns about fortified doors and a recent LODD in Denver, Colorado. Just after Columbus Fire companies received these vital tools, they would be used to save our very own.

Before the Smith Brothers' Warehouse was the fully renovated building with multiple office lofts and event spaces that it is today, it was laid out similar to its namesake. On December 12, 1994, a 2nd Alarm fire broke out on the upper floors of the building. Firefighters from Engine 1 became trapped on the upper floors while operating inside. The trapped crews soon found themselves pinned between the advancing fire and the steel framing that once held in place the glass they had broken out to notify outside crews. The new circular saws proved their value, and a ladder company was able to make quick work of the steel encasements, rescuing the trapped firefighters. Had crews not had these tools, this fire could have quickly turned into a multiple LODD incident.

BLADE TYPES

Circular saws are perhaps the fastest, least strenuous, and most powerful tools for forcible entry. CFD has a variety of saw sizes and blades. When using circular saws for forcible entry, be aware of the blade types and their uses, blade size, and orientation of the saw (inboard vs. outboard). Knowing this information will allow firefighters to grab the right saw when seconds count.

Dax Blades

Dax blades have carbide tips and are effective for flat roof operations, garage door panels, and metal fencing. The carbide tips are wider than other blades, creating a wider kerf that minimizes binding. According to the manufacturer, some of the uses for the Dax blade include the following:

- Good for cutting metals up to 3/16” thick
- Flat roof materials

Composite Blades

These are inexpensive blades great for all-around forcible entry use. Composite blades do wear down quickly when cutting multiple obstacles on the fireground. Some uses for composite blades include the following:

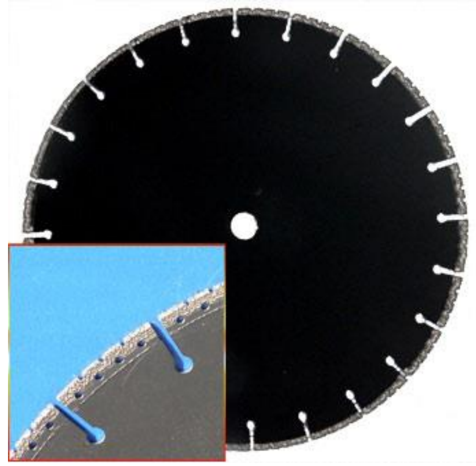
- Ferrous metals—metals that contain Iron(Fe) components
- Concrete/masonry

The photo on the right shows what remains of a composite blade after the circular saw was used to cut through a single garage door.

Diamond Blades

These are multi-purpose blades that may cut slower on certain metals compared to a composite blade, but they are much more durable. Diamond blades may be directionally dependent; firefighters must ensure they are installed correctly. Materials that diamond blades can be used on include the following:

- All metals
- Masonry



Below are links to short videos showing the cutting capabilities of the different styles of circular saw blades against some materials crews may encounter:

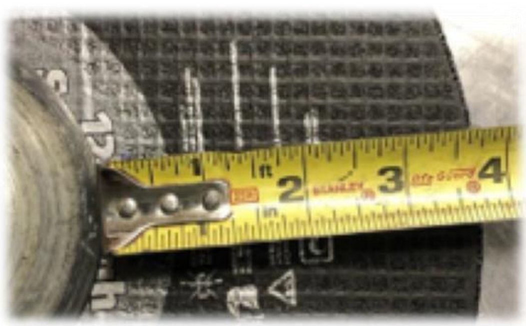
[Diamond, Dax, and Composite Blades vs. Commercial Style Locks]

[Diamond, Dax, and Composite Blades vs. Chain Link Fencing]

[Diamond, Dax, and Composite Blades vs. 1/8" Steel]

BLADE SIZE

One firefighter can conquer many forcible entry/exit tasks on the fireground with just one circular saw. In addition to the blade type, the blade size must also be considered. Columbus Fire carries both 12" and 14" blades. To cut an obstacle, firefighters must be able to reach it and be able to cut all the way through. Some advantages of the 14" saw can come into play when cutting commercial garage doors, deep seated locks, flat roof ventilation, etc. Take the blade size into consideration when performing forcible entry with a circular saw.

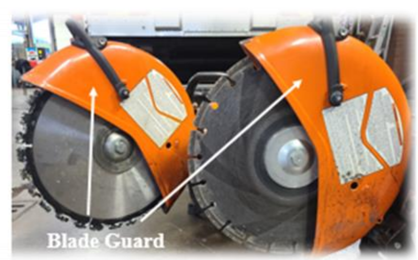


12" Blade = 3.9" max cutting depth

14" Blade = 4.9" max cutting depth

BLADE GUARD

Blade guards divert debris away from firefighters while they cut an object. During forcible entry, blade guards can also turn into an obstruction when attempting to plunge the saw into an objective. These guards can be adjusted approximately 3.5" to make it more ergonomically convenient to cut.



IN-BOARD VS. OUT-BOARD SAW ORIENTATION

When performing any cutting operation, firefighters should operate the saw at full RPMs. Doing so naturally creates what is known as a gyroscopic effect on the saw. This effect is minimized when the saw is in an In-Board (blade toward the center) orientation, and it is exaggerated when the saw is in an Out-Board (blade on the outside) orientation. The decision on which position to use is up to each individual company based on their personal preference.

In-Board

Most circular saws are oriented to the In-Board position, especially on larger more powerful saws. This is primarily due to the gyroscopic effect of the larger saws. In-Board orientation will generally be easier to handle when performing flat roof ventilation, allowing operators to place the saw onto the roof and rock it forward into the material being cut. This orientation may also be easier to control when cutting with the saw held at or above head level, such as cutting garage doors.

[Click here to view a video on Inboard vs. Outboard Saw Operations]

Out-Board

Although most saws on Columbus Fire are oriented to the In-Board position, Rescue and Ladder companies will often orient one of their saws to the Out-Board position. Blades in the out-board position are often found on the smaller and less powerful 400 or 500 series saws. Orienting the blade to the out-board position gives firefighters more versatility without compromising the saw's basic functions. Out-board oriented blades can sit flush up against the floor, wall, or door to cut obstacles that may otherwise have been more difficult to access if an inboard orientation were used. When the saw is up against an object (such as a hallway wall), the **gyroscopic effect is minimized**. Restricted space, drop pins, and carriage bolts are just a few of the obstacles where an out-board oriented saw may have an advantage over an in-board saw.

METHODS OF FORCIBLE ENTRY

OVERVIEW

This section will illustrate various forcible entry methods as they relate to the more common obstacles a firefighter may face in the City of Columbus. Firefighters should take opportunities to train and find out what tools and methods work for them. Remember, firefighters need to bring severe aggressiveness when forcing these obstacles. **We are there to save lives and livelihoods.** Anything less is a disservice to those in our running district.

"Forcible entry is a simple matter of technique and leverage."

THE IRONS

Using the Irons can be a simple tactic if used correctly. Knowing the basics of these tools and methods for their use will allow firefighters to rapidly force entry when needed. The following pages will show general steps for forcing a door using the Irons.

Click here to view a Video on General Forcible Entry Methods

COMMANDS

Communication is essential when the irons are being used by a two-person crew. An unanticipated or misplaced strike can cause serious injury that could take a firefighter out of commission for the incident. The commands should only be given by the firefighter controlling the Halligan; the firefighter with the striking tool follows the commands. The commands to be used are shown below:

- **HIT**—Firefighter controlling the striking tool performs one strike on the Halligan
- **DRIVE**—Firefighter controlling the striking tool performs continuous strikes to the Halligan until the **STOP** command is given
- **STOP**—Tells the firefighter striking the Halligan to stop driving the Halligan, or to standby while the other firefighter adjusts the Halligan or goes to force the door

INWARD SWINGING DOORS

Try Before You Pry

Trying the door first is common sense, but do not make the mistake of forgetting to do so in the heat of the moment at a hectic scene. Do not waste time trying to force an unlocked door and causing unnecessary damage.

Gap

This step will make an opening in the door to create a purchase point. If the door is poorly secured, gapping it may force the door. To gap the door, work the adz into the stop on the doorframe approximately six inches above or below the lock. If there are two locks close together, go between them. Push up or down on the Halligan tool, causing the adz to rotate and crease the door. Tighter fitting door seams may require a striking tool be used to seat the adz into place.

Shock

Shock forcefully up and down the door. Shocking hard enough may force the door open. While shocking, observe any flex, or lack thereof, in the door. This will give clues about where the locks are located.

Set

This involves driving the Halligan forks into the gap to spread the door away from the frame. Position the forks approximately six inches above or below the lock cylinder. If the tool is too close to the lock, the forks may hit the lock and will not go through to “lock in.” If the forks are too far away, the door may flex and the lock will not fail. Place the forks **(Bevel to the door)** and angle the Halligan to work around the doorstop. This is considered the ideal position; it produces the most spread between the door and the frame and puts the most stress on the locking device. It is important to “walk the Halligan” around the doorstop and frame.

Bevel to the door allows for a greater range of motion with the Halligan since the adz is facing away from the door and will not hit the door when forced. It also offers a better striking position for tight spacing. The photos on the right show the range of motion difference between bevel to the jamb and bevel to the door.

The Halligan carrying firefighter should stay focused on the fork end of the Halligan where it is being driven into the gap. Use **HIT**, **DRIVE**, and **STOP** commands to **SET** the tool. The tool is **SET** once the crotch of the forks is roughly equal with the inside of the door stop. This should ensure the forks are past the frame and will not slip off when forcing. Driving the Halligan in further will decrease the mechanical advantage.

For doors with tighter seams, firefighters can consider flipping the forks initially (bevel to the jamb) when driving the Halligan to work around the jamb and create a gap (especially for commercial metal-on-metal doors). This progress can be captured with an axe or wedge, allowing the forks to then be flipped back to bevel toward the door to force.

Force

Once the Halligan is set, the firefighter that is controlling the Halligan can force the adz/pike end forcefully toward the door, ideally defeating the locks holding it.

If the firefighter forces the Halligan all the way until it bumps against the door and the door locks are still engaged, an axe can be placed behind the Halligan to increase the distance of spreading capability.

OUTWARD SWINGING DOORS

Try Before You Pry

Trying the door first is common sense, but do not make the mistake of forgetting to do so in the heat of the moment at a hectic scene. Do not waste time trying to force an unlocked door and causing unnecessary damage.

Shock

Shocking an inward swinging door has potential to force a weaker door. Shocking an outward swinging door can be helpful for creating a purchase point on commercial metal doors where the seam is too tight to gain access for gapping. Striking a few inches away from the seam can pull the door slightly away from the jamb (photos on left).

Gap

Place the adz end into the seam of the door; a striking tool may be required to get the adz into the seam. Once the adz is driven into the seam, residential doors can be gapped at this point by working the opposite end of the Halligan (fork end) up and down.

Prior to gapping the door, the adz should be driven until it meets the door stop. This is more important on a metal door, because attempting to gap the door prior to this point could lead to "skinning" the outer portion of the door (photo on right). Once the resistance of the stop is felt, the Halligan can be rotated up or down to help gap the door.

Set

The firefighter controlling the Halligan will help guide the adz around the stop and behind the door by angling the adz toward the door. Continue to work the adz around the doorstop while striking using the **HIT**, **DRIVE**, and **STOP** commands. The adz should be approximately 2-4 inches deep, allowing the door frame to turn into a fulcrum and the adz to be secure behind the door.

Force

With the adz set, the firefighter in control of the Halligan can begin rotating the forks away from the door, forcing it open.

EXTENDING THE HALLIGAN

Sometimes more leverage is all a firefighter needs to force an obstacle. By extending the length of the tool, firefighters can obtain a greater mechanical advantage. Some examples of how to increase mechanical advantage using common tools carried by crews are shown below.

Two Halligans can be married together at their forks to increase the mechanical advantage of the tools. Make sure the two Halligans are firmly set together by using a striking tool to tap them together. If the Halligans are not set firmly together, they could come apart while firefighters are prying. This could potentially cause injury to firefighters.

A steel hook can also be used (fiberglass hooks will likely shatter if used to pry like this). Place the chisel end of the steel hook over the pike of the Halligan, and place the shaft of the hook inside the forks to pry.

A similar technique can be used to increase leverage using a steel hook and Halligan on an inward swinging door.

CARRIAGE BOLTS/DROP BARS

As mentioned previously, carriage bolts can indicate that additional locking devices have been installed on the door. These carriage bolts should be noted during the door size-up, but conventional methods should still remain the initial plan of attack because the bolts could be a false indicator of reinforcement.

Circular Saws

When carriage bolts are encountered, one of the fastest ways to defeat carriage bolt secured locking devices is by using a circular saw.

Plunge/Kerf Cut

Place the saw at an angle to cut through the metal and behind the bolt head. This will cut the shaft of the bolt in half and can cut multiple bolts that are in close proximity. Once the bolts on the hinge side of the door have been defeated, go back to using conventional methods and see if the door can be forced at that point.

Shaving Carriage Bolt Heads
A circular saw can also be used to shave the head off the bolt. This may be a better choice if crews encounter a backing plate behind the bolt heads that would make kerf cutting more difficult.

Shaving the bolt heads could leave part of the square head or a metal burr behind. These can hinder efforts to force the door, but they can be driven through the door with the Halligan pick and a striking tool.

NY Hook and Drop Bars
If firefighters are able to gain access to the drop bar itself through conventional means, then it may be possible to slide a tool through the opening. A small opening may be just enough to allow a firefighter to slide in a NY Hook or axe, allowing them to strike or lift the bar from the hinges.
[Click here to view Defeating Drop Bars with a NY Hook]

RESIDENTIAL DOORS—SINGLE FIREFIGHTER

The Tiller/OSV firefighter on a ladder company will need to prioritize tasks based on conditions and what crews need inside. Some of the first tasks often include providing entry/egress points. Forcing doors on residential house fires is often a single firefighter task. Most of the time, the task of forcing a residential door can be accomplished with a single tool. Most residential doors are some type of fiberglass, wood, or lightweight steel and are wood framed. Aggressively shocking the door will often split the frame and open the door. Always check to see if the door is already unlocked. Some methods a single firefighter can use to force residential doors with common tools from the truck are shown below. If these or other methods are unsuccessful, work promptly to **Gap, Set, Force**.

SHOCKING A RESIDENTIAL DOOR

Most residential doors are set in a wood frame. Sharp blows on the lock or in its vicinity will most likely split the frame, allowing the door to swing open.

Click here to view a Video on Shocking Residential Doors

BASEBALL SWING

Drive the "pick" end of the Halligan into the door jamb close to the door and within six inches of the lock. By deeply seating the pick into the jam, firefighters can then push the Halligan into the door. This will force the deadbolt out the other side of the door frame.

Click here to view a Video Explaining the Baseball Swing

Click here to view a Video Demonstrating the Baseball Swing

HALLIGAN AND WEDGE

A wedge (metal or wood) is great not only for door control, but also for creating/capturing purchase points. If shocking the door or using a baseball swing is unsuccessful, using a Halligan and wedge is another great option. A purchase point can be created by striking the wedge into the door where the Halligan would normally be placed when using the Irons. This will allow the firefighter to then insert the forks into the door and force as needed.

Click here to view Using a Wedge and Halligan Video 1

Click here to view Using a Wedge and Halligan Video 2

NY HOOK AND WEDGE

It is common for ladder companies to attach NY Hooks to the fly sections of ladders to free up their hands. This tool is a great asset for inside and outside firefighters. A NY Hook can be used as a striking tool along with a Halligan or a wedge. A firefighter can pin the chisel end to the structure with their foot and drive a Halligan or wedge into the door for a purchase point or for prying. The hook end can also be used as a fulcrum.

Click here to view a Video on Using the NY Hook and a Wedge

SINGLE FF OUTWARD SWINGING DOOR

A single firefighter can force outward swinging doors using the same principles as when there are two firefighters with the Irons. In this case, drive the adz in with the head of the striking tool until the adz hits the jamb. Reposition the striking tool and hit the Halligan while moving the tool the same way as with two firefighters. Wedges or a flathead axe can be used to capture progress to reposition the Halligan.

Click here to view a Video showing a Single Firefighter vs. an Outward Swinging Door

PADLOCKS

OVERVIEW

There are various types of padlocks used to secure commercial and residential property. CFD has several tools available for defeating padlocks to gain entry. Bolt cutters, circular saws, and the Irons can all be used with success. A few options for defeating padlocks are shown below. The chosen strategy may depend on what tools are available when the lock is found.

CASE HARDENED

The shackle of the padlock is often made of a case-hardened steel (sometimes identifiable on the shackle as shown in the photo on the right). Bolt cutters will have a difficult time cutting these shackles; firefighters can consider cutting the chain or using another method.

ATTACKING THE HASP

Firefighters should not get locked in on the lock itself; consider looking at the hasp mechanism. Crews may find it easier to attack the attachment plate instead of the padlock itself

SHACKLE PADLOCKS

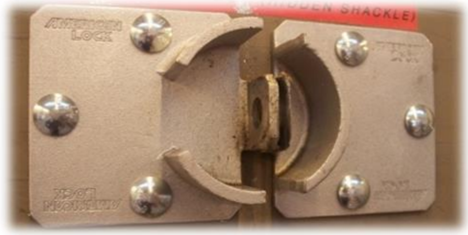
When using the Irons, multiple options are available for defeating residential or commercial shackle padlocks. The goal is to dislodge the shackle from the body by force. This can be accomplished by straddling the shackle with the forks and using the striking tool to hit downward on top of the forks. Another option is to place the pick end of the Halligan inside the shackle. Both placements of the tool will accomplish the same task. This method can be done by one or two firefighters. Another option is using the Halligan to twist the lock until it breaks. *Tip—if the lock is not accessible (ex. back side of a gate) these same principles can be accomplished using the chain itself.*

Click here to view a Video on Using the Halligan Forks to Break the Padlock

Click here to view a Video on Using the Pike to Break the Padlock

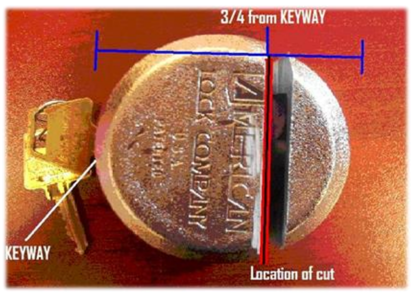
PUCK LOCKS

Hockey puck locks are another upgraded method of security. They are frequently encountered on commercial occupancies, but they are becoming more popular in residential settings. This type of lock has multiple manufacturers, but they all have a relatively similar concept. A hidden lock cylinder and shackle prevent easy access for would-be thieves. Puck locks are often recessed and protected by a steel shroud like the photos on the right. Several methods can be used to defeat this lock.



Cutting the Lock

A circular saw with a metal cutting blade can be used to cut through the lock body. Once the keyway location is identified, make a cut perpendicular to the keyway about 3/4 of the lock body away from the keyway.



Cutting Around the Lock

The security gate in the photo to the right is made of a thinner gauge metal; using a circular saw will cut through this quickly. Using a triangle cut like the one illustrated in the photo on the right will free the gate from the lock, allowing it to swing free.

Pipe Wrench

This is another option if companies carry a large enough pipe wrench and the lock is exposed (no metal sheath). Grip the lock with the pipe wrench and twist it to break the lock from the hasp.

SECURITY BARS AND STORM DOORS

OVERVIEW

Security bars are a **priority** on the fireground. Inside crews should know they will be able to bail out of any window free of obstructions. Security bars are common in both residential and commercial occupancies. The bars are usually secured by screws into masonry or siding. There are several ways firefighters can defeat security bars; most of the time the focus can be placed on the screws themselves.

LEVERAGE

Firefighters can utilize leverage by using prying tools to get behind the bars and pry outward. This will often defeat the screws themselves by stripping them out or breaking them. Focus on the screws on one side first. Next, peel the bars back toward the opposite side of the window to cause that side to fail.

FORCE

Another option is to utilize force by directly attacking the screws themselves. This can be done with striking tools, the Halligan (adz or forks) or NY Hook (chisel end). The NY Hook provides an added advantage for taller or hard to reach windows. By attacking the screws directly, firefighters can shear the screw heads off or cause the building material (ex. Masonry) around the screws to fail.

CIRCULAR SAWS

Another option is using circular saws. When using circular saws, attempt to make as few cuts as possible. Starting on one side and peeling the bars back will cause the opposite side to fail. Saws can be difficult to use for larger windows. Circular saws can be difficult or even dangerous for firefighters to handle when cutting above their heads. Consider those factors when selecting which tools to use for defeating window bars.

Click here to view Defeating Security Bars Video 1

Click here to view Defeating Security Bars Video 2

SECURITY STYLE STORM DOORS

Storm or security doors are common in all parts of Columbus. These doors can be a nuisance on the fireground because they easily swing open and closed, potentially slowing hose advancement. Control the door as needed with a wedge, or remove the door altogether. Additionally, firefighters must defeat this door prior to forcing the main door of the structure. There are various styles of storm doors. Just like with other doors, firefighters have multiple options for forcible entry. A few options are shown on the next page.

HALLIGAN METHOD

When using a Halligan, the adz end can be placed between the jam and the door; the firefighter can then pry up or down, dislodging the bolt. If the gap is too tight, drive the adz in with a striking tool. Another option for some styles of doors is a baseball swing (Video link below). Keep in mind that deadbolts on storm doors are typically much smaller than deadbolts on normal doors.

[Click here to view a Video on the Baseball Swing Method]

[Click here to view a Video on the Adz Method]

STRIKING TOOL AND WEDGE

A striking tool can be partnered with a Halligan to force the storm door using conventional Irons techniques. A good option for a single firefighter is using a wedge to drive a gap into the door to release the deadbolt. Another option could be to attack the building material housing the deadbolt. Note: These doors are designed to look fortified to the normal person, discouraging them from breaking in. Remember, storm doors are usually still secured to the same wood or masonry frame as most other doors. Do not let these doors be intimidating to you as a firefighter.

[Click here to view a Video on Using a Striking Tool and Wedge]

GARAGE DOORS

OVERVIEW

Garage or overhead doors may need to be forced for multiple reasons. Various techniques can be used depending on the end goal. There are many variables when forcing garage doors, such as garage openers, padlocks, sliding latch locks, etc. Use the path of least resistance, and use common sense. Saw selection and blade type will come into play depending on the style of door. A composite blade will often rip through most garage doors with ease. Be sure to use the full depth of the blade and allow it to do the work. Handling the saw improperly will cause binding and delay entry.

Circa 1985—Ladder 8 forcing a commercial garage door and sticking the roof

TEEPEE CUT

When rapid entry is needed, a Teepee cut is often effective. This method only requires two cuts. Be sure to **exaggerate the overlap** across cuts to ensure the material is cut all the way through. The teepee cut is generally less physically taxing than the square cut, and it can be advantageous when multiple fireground tasks need to be performed (such as multiple doors needing cut). This method also works well for firefighters of any height, allowing them to perform a taller cut. **<u>Note:</u>** Older garage doors may be wooden; chainsaws cut through these doors effectively. When using chainsaws on wooden garage doors, attempt to avoid any metal hardware holding the door panels together. Metal hardware or heavier gauge metal will generally be found near the edge of the garage door frames for the door rollers, or along the seams where the panels are joined. Some doors have a quarter turn handle lock in the middle of the door that may cause extra metal hardware to be encountered.

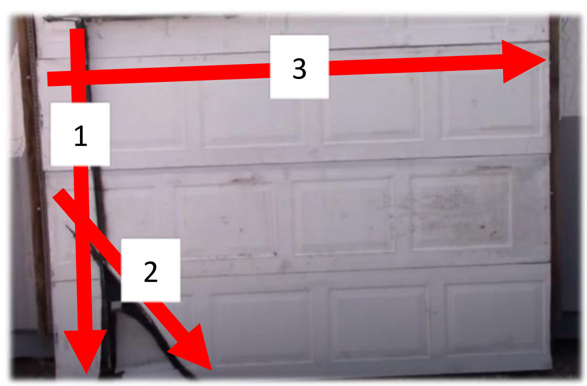
[Click here to view a Video on Cutting Wooden Garage Doors with a Chainsaw]

To do a Teepee cut, find the approximate center of the garage door. Start at the top and create a 45° cut toward the bottom of the door. The second cut is just a repeat of the first cut, on the opposite side of the door. Crews can consider not overlapping the cuts initially if they are concerned about creating a flowpath prior to a hoseline being in place. If the cuts are overlapped initially, the door may begin falling in or out as the second cut is being done. **Note:** smoke will often remain in the compartment when a Teepee cut is used. After crews have made entry through the original cut, firefighters can consider doing a Square cut later to provide better ventilation if needed.

SQUARE CUT

A Square cut is typically larger than a teepee cut; however, it can be slower. This type of cut provides additional benefits. In addition to providing better ventilation, a large square cut provides more room to place an aerial or bucket at ground level. This tactic can be used to cool steel I-beams before they fail, potentially saving the structure. A larger hole also provides easy entry and exit for interior crews.

The order in which cuts are completed is personal preference and is based on personnel and fire conditions. On larger doors, making the vertical cut first can help prevent the door from binding the blade while cutting.



1) Make a vertical cut along one side of the door all the way to the bottom of the door. Be sure to use the full depth of the blade. Staying 6"-12" in from the side of the door frame will help avoid the heavier gauge metal used to hold the door rollers.
2) If unable to completely cut through the bottom door panel, a second cut can be performed at a 45° angle across the first cut. This triangle piece can then be pushed in to give enough room to insert the saw and complete the first cut at the bottom of the door.
3) A horizontal cut can then be performed across an upper panel (cutting the top panel may lead to encountering the J-arm for the door opener, slowing down cutting). Be sure to exaggerate the overlap across cut 1. The door should now be able to be pulled back to create the opening.

COMMERCIAL ROLL-UP DOORS

Although they are not in every commercial building in Columbus, roll-up doors are commonly encountered in several running districts throughout the city. There are two common types that will be discussed below:

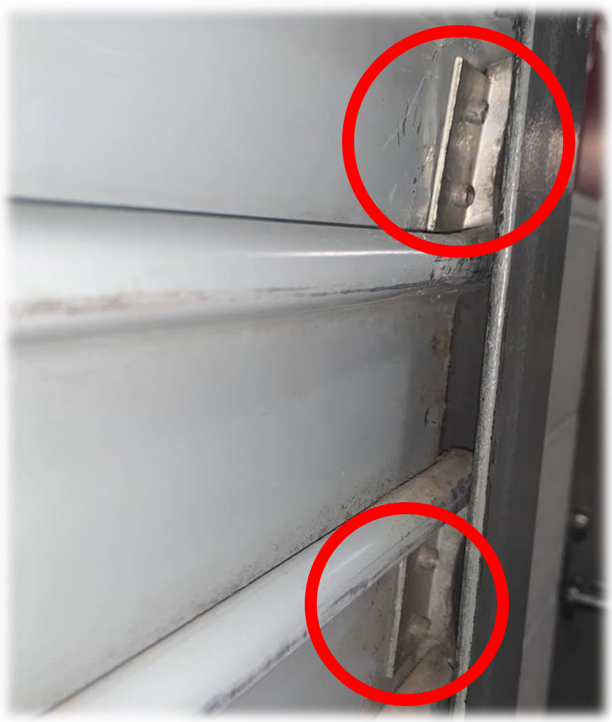
- Rolled Steel Doors
- Sheet Curtain Steel Doors

ROLLED STEEL DOORS

Rolled steel doors are found throughout the city. They are often used to protect entire storefronts from theft, or they are installed as an alternative to panel style doors. Rolled steel doors were some of the earliest style of commercial roll-up doors; they are usually a heavier gauge steel. The door consists of individual pieces of steel rolled at their ends to allow them to be interlocked together.

Identification

Rolled steel doors can be identified by their recessed seams (slats) horizontally across the door and by the rivets at the end of these slats (generally every other slat). The red circles in the photo on the right show the rivets. The rivets indicate where there are guides in the tracks. In addition, a "T" bar of two pieces of joined angle iron will often be exposed at the bottom of the door (photo below).



Forcible Entry Method

Use a circular saw to cut one large slit down the center of the door, all the way down through the T-bar at the bottom of the door. Once the cut is completed, grab an individual slat near the top of the cut with a gloved hand and pull across the cut. The goal is to pull one of the slats out. Paint, age, or warping can make pulling slats by hand difficult.

If initial resistance is felt, firefighters should attempt to pull the slat above or below the first one they tried to pull on. This is done to ensure firefighters are not pulling on a slat attached to a guide. When pulling the slat out, the slats below will generally follow in large sections and come free of the side tracks (above right photo). If the door has rivets on every slat, additional vertical cuts about 12" in from the tracks will be needed (green arrows in the photo on the right), otherwise firefighters will be unable to pull the slats with a single cut.

Paint, age, or warping can make pulling slats by hand difficult. Driving the pike end of the Halligan into a slat or using vice grips can provide a better grip for removing the slats. If firefighters are unsuccessful with using the single cut method, they could choose to use a teepee or square cut. Be prepared to use a second saw; the composite blades can wear down rapidly against the heavier gauge steel. That is why one cut and pulling the slat is the first choice.

SHEET CURTAIN STEEL DOORS

Another type of roll-up door that has become the more common style is the sheet curtain steel door. These will look similar to rolled steel doors, but they will require different techniques to be used. These are frequently encountered at storage facilities or in newer commercial buildings.

Identification

Sheet curtain steel doors primarily differ from rolled steel doors in that they do not have individual slats that are interlocked. The door may be one solid piece of metal without breaks in the face of the door, or the door may have shorter metal sheets with the ends pressed together. These doors are often made of a thinner metal than rolled steel doors.

Forcible Entry Method

Since there are no slats to be pulled, crews will need to use either a teepee or a square cut as shown previously. However, firefighters that encounter sheet curtain or rolled steel doors may not have to attack the doors at all. External locks (padlocks) are frequently used to secure these doors, especially if they are manually opened. Attacking these external locks may provide quicker access with minimal cutting. For instance, removing the discus padlock in the photo on the right allows firefighters to operate the slide bolt and manually open the door without having to do a teepee cut or square cut.

BLOCK WALLS

OVERVIEW

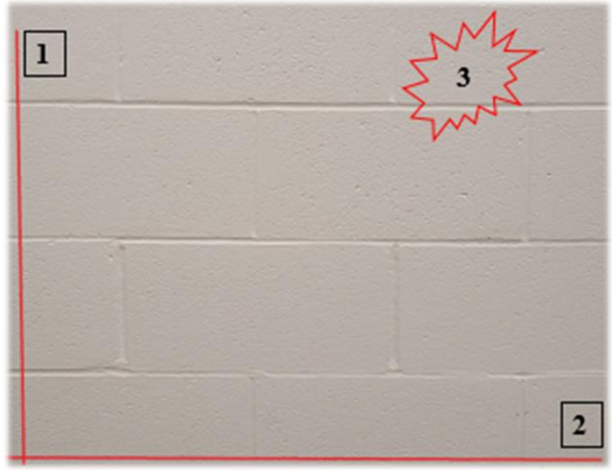
Breaching block walls should be at minimum a two-firefighter task. Firefighters could have to breach block walls in Mayday scenarios at commercial structures. Heavy steel battering rams are very effective for forcing block walls. Sledgehammers are also an option, but they can be extremely strenuous. By alternating hits using sledgehammers, firefighters can create a hole in sufficient time while reducing fatigue as much as possible. The hole that is created does not have to be large; it just needs to be big enough for a firefighter to crawl out of or even to pass a UAC/EBSS hose through for air supply. Block walls can vary in style, and they may even contain wire mesh or rebar. Block walls can also be backfilled with gravel; firefighters will need to adapt accordingly.

"In a mayday situation, Ladder 8's plan was to create a hole every 10 paces." FF Ed Eldred (Badge 1) – Ladder 8 Retired

METHOD ONE—PYRAMID

Firefighters can strike through the hollow cavity of the block at about waist height and work downward to create a pyramid shape. A pyramid shape maintains the integrity of the building and still creates a big enough area for a firefighter to crawl out.

METHOD TWO—L SHAPE



Firefighters can start at approximately waist height and work straight down. Next, start working in a horizontal direction near the floor to create an outline of the desired hole. After the L shape is complete, hit in the upper corner opposite of the L shape (Indicated by the 3 in the photo on the right). Keep working back toward the upper part of the L shape until the whole portion of the wall has fallen.

This block wall below contained truss-style stainless steel joint reinforcement wiring. The most common size is usually 9 gauge, which is able to be cut using cable cutters. A good practice is to have a circular saw on standby in anticipation of encountering reinforcements such as rebar or other steel wiring.

OTHER FORCIBLE ENTRY CONSIDERATIONS

OVERVIEW

Like most things in the fire service, forcible entry is never black and white. Firefighters can learn through experience, training, and listening to those who have been there. By training the fundamentals of forcible entry and capturing a good size-up, firefighters can successfully force doors for timely entry and exit. However, there are always considerations based on each incident. A few considerations to keep in mind will be illustrated on the following pages.

READING CONDITIONS BEYOND THE DOOR

Firefighters often talk about reading smoke in regards to fireground tactics and strategies. When forcing entry into a structure, firefighters should be aware of what the smoke conditions are telling them. If firefighters notice smoke pushing or "breathing" behind the door, there may be consequences when that door is forced open. This does not mean firefighters must stop operations, but knowing what may potentially happen may change the strategy. Regardless, firefighters still need to make entry to preserve life and property. This can be as simple as staying low while forcing a door and letting the fire/smoke light off above. Firefighters should consider whether a hose line needs to be in place prior to forcing the door.



At 0740, E-29 arrived first due to a working fire in the Clubhouse building of an apartment complex. Upon arrival, a maintenance worker gave E-29 the door code to the front door of the Clubhouse. While advancing the line to the next door, E-29 was met with heavier smoke conditions. Having arrived well ahead of the first due ladder company, E-29 forced the fire room door. Upon forcing the door, the IDLH atmosphere now received the rest of the oxygen it needed to ignite violently. E-29 crew members experienced high heat conditions that damaged their PPE. With quick reactions and the experience level of the crew, they were able to quickly react and contain the fire.

DOOR CONTROL

Firefighters should pride themselves on their ability to force obstacles for both entry and egress purposes. **On a ladder company, it is the duty of the outside firefighter to serve those on the inside, both the firefighters and the potential victims.** By creating entry and exit points, firefighters create a safer environment for those inside.

"A Firefighter is only as safe as their last known exit."

Firefighters should be aware of some key points when forcing doors and other objects; they should consider any potential consequences that may result from doing so. This is not to say firefighters need to be overly cautious when opening up the structure; it is still vital for them to do so. However, firefighters need to use a commonsense approach. Some considerations regarding door control are shown below:

- Forcible entry is another means of horizontal ventilation. It is **OKAY** to force doors/objects at a fire with a hose line in place. For the first arriving ladder with no hose line present, forcible entry is **STILL OKAY**; however, door control becomes more of a factor and the clock is ticking. Ensure the fire compartment stays isolated as much as possible to prevent fire spread. Firefighters still need to do their job to preserve **LIFE**. Search with water cans if necessary
- When forcing any door, firefighters should ensure it cannot lock behind them. Firefighters are only as safe as their last known exit. In addition, it is counterproductive to force a door ahead of an engine company, only for them to have to force the door a second time, delaying operations. A door chock or other type of door stop can pay dividends throughout the incident

L-12 Premade door stop

- Many homes have security doors or screen doors that often freely swing open and shut. These doors can easily cause headaches for interior crews as they advance hose lines and cord reels. If these doors become a hindrance to smooth hose line and fireground operations, they should be removed
- When forcing a door with smoke conditions present, observe where the smoke is at the door and observe any air entrainment entering the structure. Information such as this can provide vital information on the potential seat of the fire
- By getting to ground level of a smoke-filled doorway, a firefighter can better learn the layout of the structure. In addition, any victims who attempted to exit may possibly be seen by firefighters at this level. Firefighters should use this to their advantage

Click here to view a Video on Removing Screen Doors

LARGE OCCUPANCIES—STRIP MALLS

Strip malls can be just a few businesses in length, or they can span an entire block. In regards to forcible entry, initial companies arriving on scene should consider the following:

- Doors may not be addressed in the rear. Ensure the location and initial actions are well communicated
- If going to the rear, it may be beneficial to count units to take note of how many businesses are in the incident. This can help firefighters prioritize forcible entry more effectively. Long strip malls with no address in the rear can be cause for confusion, resulting in a delay of entry/exit for fire attack companies
- Multiple security measures are usually utilized when securing a rear door; a proper size-up and appropriate tool selection is crucial. Consider hydraulic tools and circular saws.

Engine and Ladder 32 pull up to a working fire at a business in a strip mall. The second due ladder pulled around to the rear to set up and gain access in the rear. Multiple doors were forced for quick containment, quick means of egress, and for search and ventilation. The following videos explain the initial thoughts, actions, and considerations for the incident.

Click here to view Initial Thoughts and Set-Up

Click here to view Issues and Considerations

Click here to view Forcible Entry Walk Through

Click here to view A Look at the Rear

ARRIVAL ORDER

E-6 and L-24 were dispatched to a fire alarm at a restaurant in the evening during May of 2018. As E-6 pulled on scene first, they found heavy fire conditions present and immediately started a full working fire assignment. E-6 was the first on scene company since L-24 was still en-route. E-6 crew members forced the rear commercial door using the Irons to quickly attack this fire with a 2.5” handline.

“It’s a fire until you get there, only then is it truly just an alarm.”
Lt. Larry James (Retired), Engine 6

HOARDING

By going into dozens of homes on EMS calls and other runs, firefighters will often see doors that are not utilized by the homeowner. This could be due to furniture or other obstacles that may be behind the door. The Division encounters several of these hoarder-like conditions each year, and the clutter alone can present a hazard for us. If there is a considerable delay in entry, look at using another door or even a window. As a single firefighter, do not spend the entire fire trying to force a door that requires multiple people. There are too many other tasks to accomplish.

RESTRICTED SPACE

Forcible entry is often about technique and leverage. Many times, firefighters can increase their leverage by using a longer tool or even by marrying tools such as a Halligan and a NY Hook. Unfortunately, this is not always possible. Although uncommon, firefighters may need to force doors or other obstacles where their movement is restricted. Not only can the working space be restricted, but recessed doors (photo on the right) can compound difficulty. These situations take special consideration and may even cause further delay depending on the obstacle.

In 2019, Station 16 was first due to a reported fire at a church. Upon arrival, Engine and Rescue 16 communicated a working basement fire and determined the best point of entry was on the Bravo side of the structure down a set of cellar stairs to the basement. The door to the basement was down a flight of steps surrounded by brick. This door caused challenges that firefighters do not ordinally face on residential structures. However, Rescue and Engine 16 quickly adapted and performed a fast, aggressive attack, saving the structure. The video that is linked below reviews the first-in companies' initial thoughts, actions, and lessons learned.

Click here to view video of FF Powell talking about the incident

Takeaways

- **Have a plan and work though it from A-Z**
- **Consider taking circular saws up to commercial structures**
- **Hydraulic tools can be used to force or crush doors to gain better purchase points**

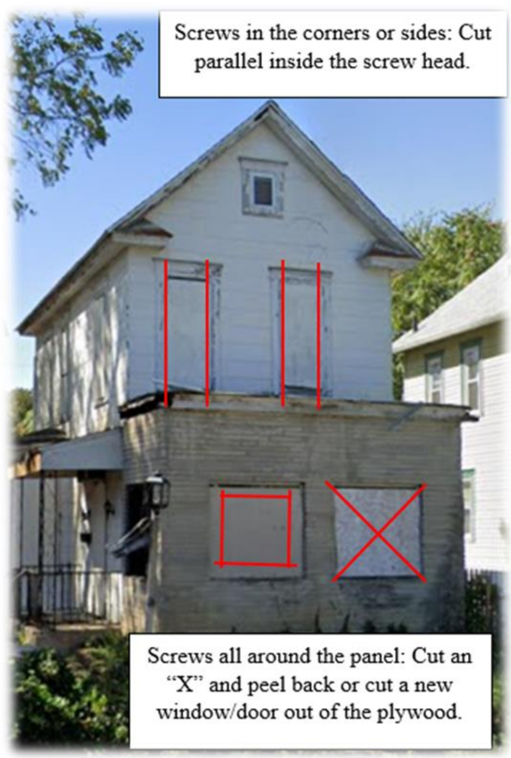
VACANT STRUCTURES

Columbus has no shortage of vacant buildings, both residential and commercial. It is important for firefighters to be aware of what type of vacant structures are in their run districts. This allows firefighters to be aware of specific hazards or challenges that may lie ahead. There are many reasons why a building may be vacant, but firefighters should not write off such a structure because they <u>think</u> it is abandoned. There still may be lives inside, and there is still property to save. Vacant structures can present additional challenges to the outside ladder team. Often, these structures have obstacles over entry points to prevent people from coming in. These may include plywood, Vacant Property Security (VPS) Systems, or polycarbonate window coverings. Removing these coverings is critical for the safety of firefighters and potential victims inside.

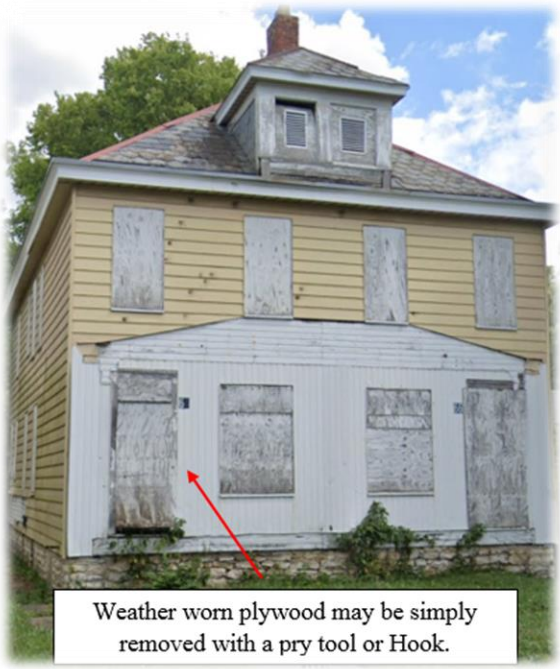
Similar to drop bars, carriage bolts can indicate the plywood is secured from behind. A chainsaw can still defeat this by plunging in past the 2x4.

Plywood

Plywood covers are the most common obstacle encountered at vacant structures in Columbus. A chainsaw is the most efficient tool when attempting to remove these quickly. Depending how the plywood is fastened, making parallel cuts inside the screws provides a fast opening over a window or door. One cut down the middle allows a firefighter to peel back the sheets until the wood or screws fail. If this does not work, cutting an "X" or "cross" to subdivide the panel can make it easier for the plywood to be removed. This can be accomplished off a ladder or on the ground. If possible, coordinate with other outside ladder firefighters, RIT, or even the first-in medic to allow this task to be completed more quickly.



"As a first in ladder company with crews inside, forget fans, forget lights, boarded windows must become the priority." FF Joe McGee, L-12, 2 Unit


Weather worn plywood may be simply removed with a pry tool or Hook.

Vacant Protection Systems (VPS)

Vacant Protection Systems are a more secure method of preventing entry into a vacant structure. Although this is beneficial to the owner, it can be more challenging for firefighters. These coverings will most likely require a 14” circular saw to plunge through the 14-gauge steel cover and cut the support bar on the other side of the window. If carriage bolts are present, attempting to attack them just like carriage bolts on a commercial door may work also. VPS doors have a variety of locking mechanisms—drop pins, cables, color codes, etc. A PowerPoint that goes into more detail about VPS systems is linked below.

[Click here to view a PowerPoint on VPS Systems]


VPS being used in Batt. 5

TAKE PRIDE IN YOUR CRAFT

By Lt. Stephen Saksa

"When the decision is made to force entry into a building, the speed, method, and the amount of acceptable damage are always determined by the extent of the emergency. While working on an Engine Company, we were dispatched to a possible DOA. Upon arrival we were able to see the resident through a window; unfortunately, he was obviously deceased. This allowed us to slow down the pace of entry into the house, which was a newer structure of lightweight construction. This is where overconfidence became a problem. I made the decision to use the Halligan bar to "spike" the jamb with the pike of the tool, and the door would not open after multiple attempts with this technique. We decided to use the rabbit tool, thinking it would have no trouble at all with a common residential door set in a wood frame. The tool was placed and the jaws started to open, but the door remained solid. The rabbit tool was unable to pop the door because the force was actually pushing out the wall of the house. Eventually, we broke a window to gain access for the medic and CPD.

According to the neighbors we spoke to on the scene, the resident recently had his house broken into. He had purchased a kit that reinforced both the door and the jamb to prevent another breaking and entering. The kit made the door and the jamb much stronger with the addition of metal plates and longer screws into the strike plate. These additions made entry extremely difficult to say the least, and it delayed our entry into the house.

My takeaways from this run were many: never underestimate a door, always have a Plan B, Plan C, and so on. The worst thing we can do as a company is to just watch others forcing entry. As one company works, get a plan together to be ready in case of failure by the first company, and always be looking for alternate entry points. If entry is gained, make sure we announce this fact over the talk group. As you shop in your local home improvement stores, look at the selection of locks and security devices; you may encounter these in your running districts. Forcible entry is not just a Ladder Company function. Especially at single Engine Houses, consider putting together your own kit with various tools.

One of the many benefits of the internet and social media is the number of websites and pages dedicated to the art of forcing entry into structures. I encourage you to use these resources and to pass along the things you learn to fellow firefighters to make all of us better at our chosen profession."

SEARCH AND RESCUE OVERVIEW

TRUCK OPERATIONS MANUAL

SECTION TOPICS

Search and Rescue Overview

Search and Rescue Size-Up Factors

Residential Search and Rescue

Vent Enter Isolate Search (VEIS)

Victim Removal

Search Rope Deployment

SECTION OBJECTIVES

Identify search and rescue size-up factors

Understand the order in which rescue efforts should be performed

Understand statistics about common victim rescue locations

Understand the procedure for performing VEIS

Understand packaging and drag techniques

Understand techniques for removing victims out of windows and down ground ladders

Understand how to deploy search rope when performing wide area search

Understand how to deploy search rope when searching for a downed firefighter

SEARCH AND RESCUE

OVERVIEW

- This section is intended to review statistics about rescues that have been performed across the country, review basic search and rescue size-up factors, familiarize on-company personnel with how search is being taught in the Training Academy and what can be expected from a recently graduated recruit, and provide guidance and examples of less common types of searches, such as VEIS or searching with a rope bag
- Search and Rescue is one of the ladder company's primary jobs
- Ideally, Search and Rescue should be performed by two or more firefighters
- Search and Rescue is performed by the interior crew of the ladder company
- Obtaining a Primary All Clear is one of the most critical benchmarks achieved on the fireground
- Search and Rescue should be rapid yet thorough; it is performed before or during fire suppression
- Firefighters primarily search for victims, but they also search for the seat of the fire and relay that information to the engine company attacking the fire

CONTENTS

- Search and Rescue Size-Up Factors
- Residential Search and Rescue
- VEIS
- Victim Removal
    - Packaging and Drags
    - Removing Victims out of Windows
    - Ground Ladder Rescues
- Search Rope Deployment
    - Accountability
    - Anchoring the Rope
    - Rope Bag Placement
    - Commercial/Wide Area Search
    - RIT Operations—Searching for a Downed Firefighter
    - Tying Off the Rope
    - Tagline Use
    - Additional Considerations

SEARCH AND RESCUE SIZE-UP FACTORS

OVERVIEW

- Saving lives is the Columbus Division of Fire's highest incident priority
- Some of the greatest exposure to danger for firefighters occurs during primary search and rescue operations
- Size-up is a conscious process involving the rapid but deliberate consideration of critical factors and the development of an action plan based on those factors
- Firefighters must constantly be sizing up the structure, prior to entry and throughout the search, to ensure their safety
- Size-up factors specific to performing a primary search could include the following:
  - Known life hazard vs. potential life hazard
  - Occupant accountability/survivability
  - Number, location, and condition of victims
  - Building construction
  - Size and extent of the fire
  - Hazards to search crews
  - Established water source
  - Available equipment/staffing
  - Firefighter experience levels
- An inexperienced firefighter might not have the skill level needed to recognize the signs of imminent danger. They may search too far without a hose line, commit too far into the structure, and not have enough air to make an exit. An inexperienced firefighter should be more cautious about how far to commit themselves into the building
- An experienced firefighter may be able to avoid hazards by recalling similar experiences at previous structure fires
- By looking at the outside of the structure, firefighters can form an idea of what the interior building layout is. The presence of small windows can indicate the location of a bathroom or a kitchen. A window halfway between the first and second floor (circled area in the photo to the right) usually indicates the location of the stairs
- Special caution should be taken when searching hoarder houses or vacants
- Rescue efforts should be performed in the following order:
  - The most severely threatened
  - The largest number (groups)
  - The remainder of the fire area
  - Exposures

RISK VS. REWARD

Firefighters need to understand the risk vs. reward aspect of primary search. Is the heat forcing firefighters to a lower position than a 3-point stance? If firefighters are feeling significant heat even with the high levels of protection provided by today's fire gear, then a victim with no gear to protect them will likely not survive in that amount of heat/smoke. In some situations, firefighters can push farther into structures than in other situations. For example, firefighters that encounter a kitchen fire on the first floor of a two- or three-story wood frame home with significant smoke throughout the structure might search longer if they know the fire has been suppressed by the engine company. However, firefighters may choose not to search as far into a house if they are operating above the fire, or if the engine company does not yet have water on the fire. Firefighters should remember window locations as they go in case conditions change and a quick exit is required. The member in charge of the primary search will also be monitoring the radio to listen for changes in conditions on the fire ground by other members or the IC. Remember, an aggressive search is controlled, methodical, and deliberate. Firefighters will need to constantly be evaluating their surroundings to determine how far and how long to commit into the structure.

182 E. North Broadway

By FF Mike Powell (2 Unit R16)

On arrival, is there any info that can be gathered from the occupants or bystanders? As I arrived on the scene of a working fire where the back of the house was involved and extending into the rear door and windows, the occupant was exiting the front door. Heavy black smoke was banking down to one foot off the floor level in the doorway. The occupant stated, "My son and husband are on the second floor!" There were three steps up from the front yard to get to the floor level of the house. While masking up, I could clearly see twenty feet into the front door where a male was lying unconscious at the base of the stairs. Staying low and getting a visual below the smoke could give you some valuable information. In this instance, we had a clear path to a victim. After removing the victim, my partner and I headed back to the stairs. At the top of the stairs there was a moderate amount of heat and near zero visibility. We had a choice to go left or right; we choose to go left. I heard a faint call for help. As we progressed, I heard it again and we came to a door. The victim stumbled into the hallway and went unconscious. I immediately radioed we had a victim and to send crews to meet us at the top of the stairs. We had two people assist us and we successfully removed victim number two.

The structure where the rescue occurred. By continuing to size up the structure even while masking up, FF Powell was able to see a victim at floor level twenty feet into the building and make the rescue, even though the occupant said that both victims were on the second floor

RESIDENTIAL SEARCH AND RESCUE

OVERVIEW

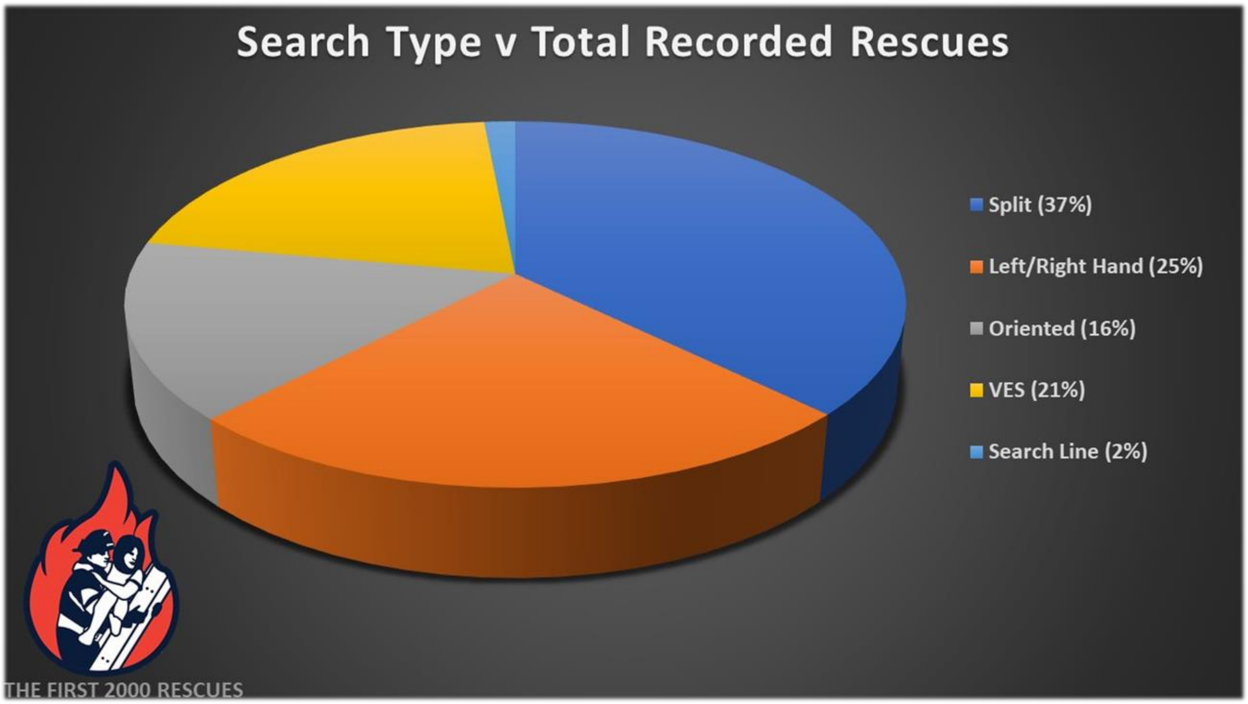
- This section is not designed to be a step-by-step tutorial of how firefighters should perform search and rescue in residential structures. Apprentice firefighters should already be familiar with basic search and rescue techniques
- As part of their Firefighter II state certification in the Training Academy, recruits are taught an oriented partner search where one firefighter stays oriented at the door to the room while the other firefighter searches inside that room
- Apprentice firefighters should train on search and rescue with their officer and crew to determine exactly what the officer expects of them while searching at a fire. Officers should clearly communicate to the crew their expectations of how search will be performed in various scenarios

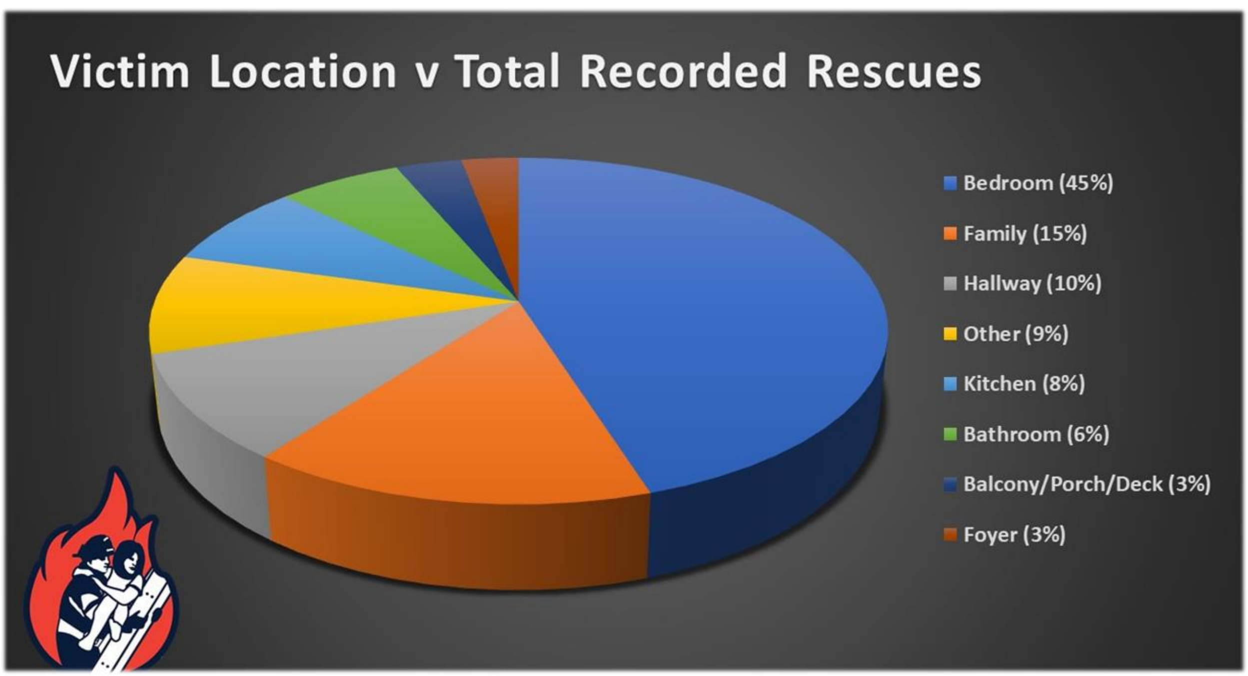
SEARCH AND RESCUE STATISTICS

- Before 2016, very little data existed about victims rescued from fires by firefighters. NFIRS reports typically only state negative information such as losses, fatalities, and injuries
- In 2016, a group of firefighters who had been collecting reports of victims rescued by firefighters decided to develop the Firefighter Rescue Survey to record details of rescues performed on the fireground
- The idea behind gathering this data is that if firefighters can see which techniques have been successful in past rescues, training methods could then be tailored to use those techniques that have actually worked in real incidents across the nation
- The following statistics were retrieved from the first 2,000 rescues recorded by the Firefighter Rescue Survey (https://www.firefighterrescuesurvey.com/):
    - Crews assigned to primary search made 58% of the rescues
    - Fire attack team made 25% of the rescues
    - Crews assigned to secondary search made 4% of the rescues
    - Bystanders/occupants reported that victims were inside 69% of the times that victims were found
    - There was no report from bystanders/occupants on potential victims 28% of the time that victims were found
    - 3% of the victims were found after bystanders/occupants reported that everybody was out of the building

SEARCH AND RESCUE STATISTICS CONT.

- Victim locations for the 2,000 rescues were as follows:
  - Basement—4%
  - First floor—57%
  - Second Floor—30%
  - Third Floor—7%
  - >Third Floor—2%
- Additional information is shown below





TIPS FOR PRIMARY SEARCH

- Ask occupants what floor any potential victims are on, their location on that floor, and how many victims there are
- If possible, ask the neighbors if anyone is home
- Do not forget your sense of hearing; it could alert you to being in close proximity to a victim. We cannot limit our skill set to searching by feel; we also need to be listening for shouts for help or cries from a child
- Can we make quick entry into the upper floors? Possibly through a window or porch roof via ground ladder or aerial ladder?
- Firefighters cannot underestimate the advantage of a thermal imaging camera. They have proven to be one of the most effective search tools available to firefighters. TICs can show room layout and help locate windows for a means of egress or for patient removal
- Always carry a tool! Firefighters should use their tool to sweep out away from the wall to cover as much area as possible
- Firefighters should also sweep out in front of themselves, checking for holes or burned-out areas as well as monitoring the structural integrity of the floor
- Firefighters should notify incident command of their progress. Examples could include **"Primary All Clear," "All Clear on two,"** or **"All Clear on the fire apartment"**
- Radio traffic and messages to the IC should be clear and concise
- Firefighters need to stay orientated to the area to enable a rapid exit if necessary due to a rapid change in conditions, an equipment failure, or a crew injury
- If firefighters cannot see their feet, they should be in a 3-point stance. This also gives firefighters the best chance at survival if there is rapid fire development or a flashover
- If a victim is located near a window, firefighters should consider removing that victim through the window onto two egress ladders or directly to a porch roof. Taking the victim back the way firefighters entered makes the victim's time in the environment much longer

VENT ENTER ISOLATE SEARCH (VEIS)

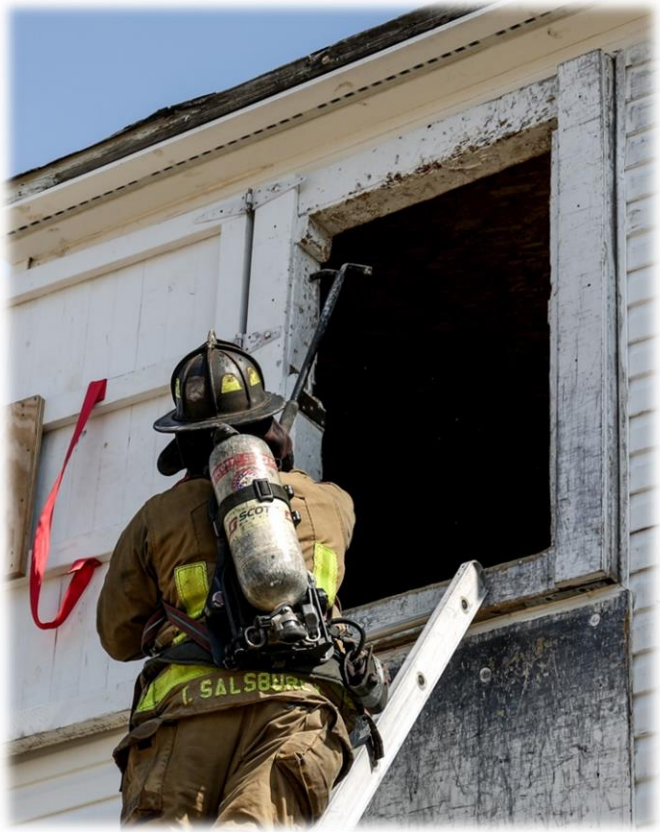
OVERVIEW

- VEIS is an effective tactic for incidents where there is potential to save a victim that can be accessed more readily via a window than by other means
- VEIS was used for 21% of the first 2,000 rescues recorded by the Firefighter Rescue Survey
- VEIS could be performed on a first-floor window without a ladder depending on the height of the window. A firefighter could lean a Halligan against the wall below the window to use as a step to get into the window if extra height is needed
- If a ladder is used to a second-floor window, the ladder should be as close to a 75° angle as possible. There may be instances on a split-level home where a 75° angle with the ladder is not possible. Performing VEIS is still achievable in those cases; simply place the ladder to the best angle possible based on the situation as shown in the photo on the right
- Ideally, the tip of the ladder should be in the rescue position just below the windowsill, with no point of the ladder protruding into the window where it could impede egress for either the rescuers or the victims

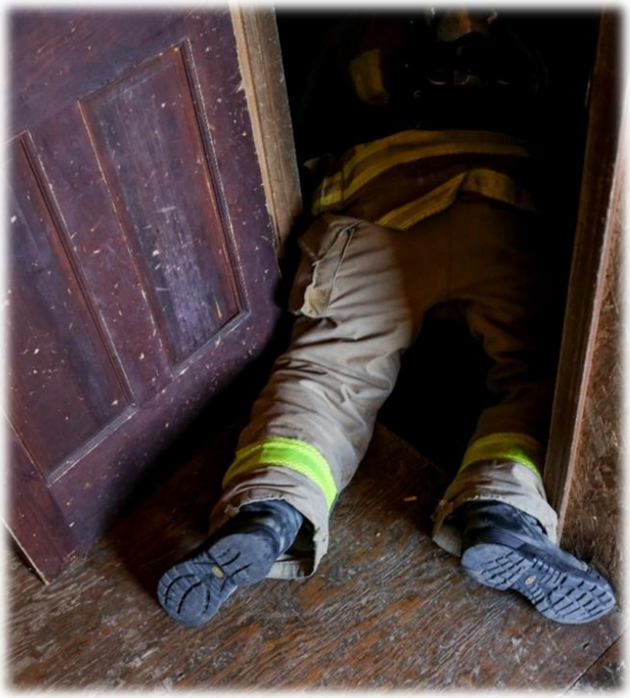
Click here to view a video on Vent Enter Isolate Search (VEIS)

After ensuring the ladder is properly placed, the VEIS firefighter has ascended the ladder while wearing full PPE and SCBA. This firefighter has chosen to use a New York style Z hook to clear the window. A fiberglass hook tends to bounce off a traditional window sash. Other tools such as a Halligan can be used, but it may be more difficult to clear the glass from the top of the window due to the shorter reach of the Halligan.

The firefighter should use the tool to clean out all shards of glass, blinds, or curtains that could impede the firefighter from entering or exiting rapidly through the window. After clearing the glass and other obstacles, the firefighter will sweep the floor directly below the window with his hand as shown in the photo below. This is done to ensure there is no victim present prior to sounding the floor.



The firefighter then sounds the floor with his tool to ensure the floor is present and that it will hold his weight. Next, the firefighter enters the window headfirst, staying low in the window to avoid any heat and smoke that is present.



Immediately after entering through the window, the firefighter should look across the floor before starting the search. Depending on the fire conditions, there may be some visibility near the floor that would allow the firefighter to see the location of the door to the room or any potential victims. The firefighter then moves to the opposite wall to look for the door.

Once the door is located, the firefighter will make a brief sweep into the hallway to check for any potential victims there. This is also a good time for the firefighter to monitor the fire conditions that are present. If no victims are found in the hallway, the firefighter moves back into the room and closes the door to isolate the room from any fire and smoke

It is very important for the firefighter to close the door to isolate the room. This will help provide a barrier to protect the firefighter from fire conditions while completing a search of the room. Closing the door also helps protect any victims that could be present.

A VEIS search should be rapid, yet thorough; it should cover all points of the room. If a bed is present, the firefighter should reach upward or check for bunk posts to ensure there is not a bunk bed. The firefighter must ensure there is not a victim wrapped up in any sheets or blankets on the bed.

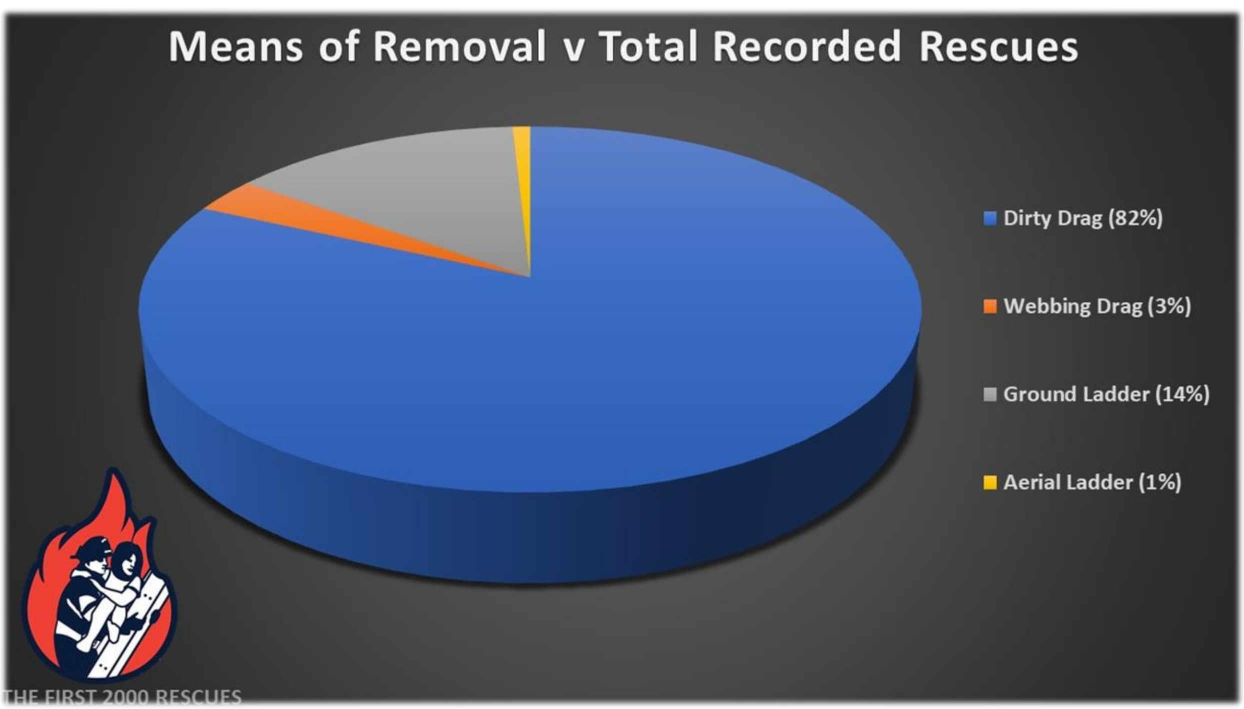
The second firefighter involved in the VEIS search has several responsibilities. Ideally, this firefighter will have a TIC to scan the ceiling to check the heat levels and ensure the room is tenable. The firefighter will also scan the room with the TIC to check for victims. In addition, the second firefighter stays oriented at the window and remains in verbal contact with the interior firefighter.

If at any point conditions become untenable, the interior firefighter can rapidly exit via the ladder. The second firefighter will have a better vantage point to monitor the conditions than the firefighter that is actively searching. If a victim is found halfway through the search, remove the victim and notify command. Remember to check for other victims! Just because one victim has been removed from a room does not mean there is an All Clear on that room. For techniques involving removing victims out of windows and down ground ladders, refer to the next section of this manual: Victim Removal.

VICTIM REMOVAL

OVERVIEW

- This section of the manual will show some common techniques for removing victims out of windows and down ground ladders
- Basic packaging and drag techniques will also be demonstrated
- Firefighters should understand that the packaging and drag techniques demonstrated here are just a few of many options available
- Firefighters could consider some of the following factors when deciding what technique to use for victim removal:
    - Size of the victim
    - Current fire conditions
    - Amount of staffing available to help
    - Distance to the nearest exit
- Firefighters should not fall into the trap of always pulling the victim out the same entrance where the firefighter came in. The closest exit that will allow for the quickest victim removal is where the firefighter should drag the victim
- The chart below shows the results from 2,000 different rescues that have been performed since the inception of the Firefighter Rescue Survey
- In 82% of those rescues, a "dirty drag" was used to remove the victim. "Dirty drag" means that firefighters removed the victim by dragging them without using webbing or tools. Webbing drags were used in 3% of those rescues
- In those 2,000 rescues, victims were removed via ground ladder 14% of the time, and an aerial ladder was used 1% of the time



PACKAGING AND DRAGS

- Since the majority of victims are rescued by firefighters doing drags without the use of webbing or tools, two types of "dirty drags" will be discussed:
    - Headfirst Drag
    - Feetfirst Drag
- Webbing drags and tool drags will also be demonstrated
- These types of packaging and drags are just a few of many options that exist. Firefighters will need to make a decision on how to package and how to drag based on the needs of the specific situation they are in, the size of the victim, and the fire conditions present

Headfirst Drag

For a headfirst drag, the rescuer will sit the victim up and reach both arms around the victim's torso. The rescuer can either grasp both of the victim's wrists as shown in the photo to the left, or the rescuer can grasp their own wrist to completely encircle the victim's torso. The rescuer should be in a 3-point stance and keep one leg forward toward the victim. Once ready to move, the rescuer will extend their front leg while pulling the victim toward them in a rowing motion. Short, quick movements are best with this technique. This technique is difficult to perform on a victim whose upper torso is too large for the rescuer to be able to reach around.

Feetfirst Drag

For a feetfirst drag, the rescuer will lift both of the victim's legs and either place both legs over one shoulder or put one leg over each shoulder. The rescuer will then reach both arms around the victim's legs and interlock their hands as shown in the photo to the right. The goal is to lock out the victim's knees. The rescuer should again be in a 3-point stance with one leg forward toward the victim. Once ready to move, the rescuer will extend their front leg while pulling the victim toward them. Short, quick pulls tend to work best. This technique is tiring and tends to be best suited for drags over short distances.

Webbing Drag

To do a webbing drag, the rescuer would first package the victim by using a girth hitch. The girth hitch should be as high and tight in the victim's armpits as possible. If the girth hitch is not tight at the beginning, it can loosen and slip off over the victim's head during the drag. In the photo to the left, the rescuer is using one hand to do the drag. In this case, the rescuer turns to face the direction of travel, allowing them to drive off of their back leg. The rescuer should make sure not to pull the weight of the victim on top of their back foot, causing them to have to reset before pulling again

For heavier victims, the rescuer can choose to drag with two hands grasping the webbing as shown in the photo to the right. In this case, the rescuer will face toward the victim in a 3-point stance. Once ready to move, the rescuer will extend their front leg while pulling the victim toward them in a rowing motion. This technique tends to be slower than dragging with one hand, but it works better for large victims. The rescuer should keep as much of the victim's torso off the ground as possible to reduce the friction of the victim dragging on the floor

Tool Drag

Another option is the tool drag. The rescuer slides a hand tool under the victim's arms and grasps the tool just outside the victim's armpits. The rescuer is again in a 3-point stance and extends their front leg while pulling the victim toward them in a rowing motion. This technique has several disadvantages. It can be difficult to fit the tool through a doorway, and the tool tends to slide out from under the victim's arms. However, this technique could be an option if webbing is unavailable and the victim is too large for the rescuer to reach around their torso for a headfirst drag.

REMOVING VICTIMS OUT OF WINDOWS

- In some cases, it may be faster to remove a victim out of a window rather than dragging the victim to a doorway to exit
- Lifting an unconscious, burned victim up and out of a window can be an extremely physically demanding task. Remember that performing a window cutdown can be a great option. Refer to the *Saving Our Own Manual-Window Cutdowns* for further information about performing window cutdowns
- Depending on the size of the victim and the strength of the firefighter, lifting the victim out of the window may not be difficult. However, this manual will discuss two specific techniques for lifting large victims out a window based on the position in which the victim is found:
    - Head Toward the Window Technique
    - Feet Toward the Window Technique
- Firefighters should notify Incident Command if they need any additional resources to perform the rescue

<u>Head Toward the Window</u>

The following section will demonstrate the technique utilized when the victim is found with their head pointed toward the window. The firefighter can use one of the previously mentioned drags to get the victim to the base of the window.

The rescuer will try to place one of the victim's shoulders as close to the wall as possible, with the victim's head off to the side. Next, the inside rescuer will communicate to the outside rescuer which way the victim will be coming out of the window. In this case with the victim's head toward the window, the inside rescuer will lift the victim's legs and the victim will come out the window feetfirst. The outside rescuer should be prepared to assist with lifting as soon as the victim is within reach

The photo to the right shows the inside rescuer placing the victim's legs over one shoulder and preparing to lift them out the window. The inside rescuer should be in a crouching position and use their legs to lift, not their back. The inside rescuer will then lift the victim's legs up and out of the window as shown in the photo below.

Depending on the size of the victim, it may take several tries to get the victim's hips up onto the windowsill. Whenever the rescuers reset for another try, the outside rescuer should pin the victim's legs against the windowsill to keep the victim from sliding back inside. The inside rescuer should pin the victim against the wall and slide down, trying to get leverage by grabbing the victim's shoulder.

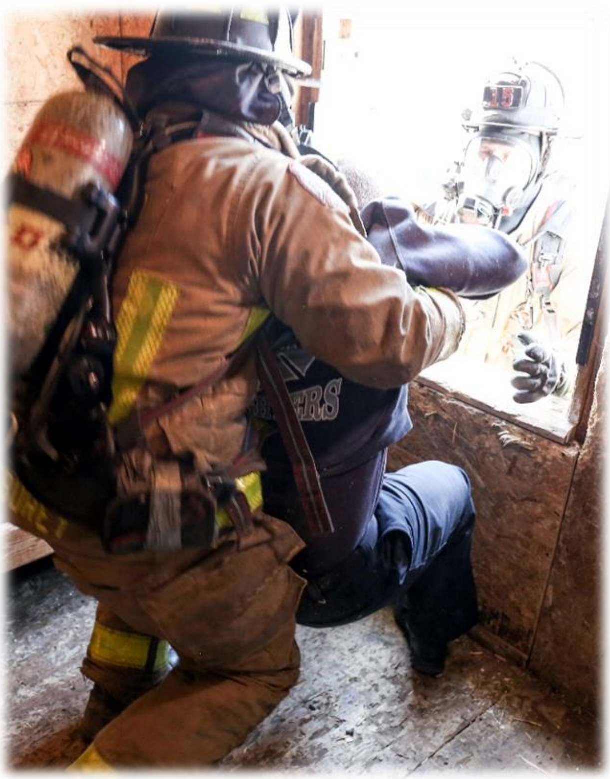
Once the victim's hips are on the windowsill, the rescuers can use the windowsill as a fulcrum to pivot the victim over the windowsill as shown in the photo to the left. If the inside rescuer is handing the victim out to a rescuer on a ladder, communication between the rescuers is critical to ensure the outside rescuer has a firm hold on the victim to keep from dropping them. If the rescuers were proactive and communicated to Incident Command as soon as the victim was found, the Incident Commander will likely have EMS waiting at the point of egress to allow the victim to be passed off and receive medical care immediately.

<u>Feet Toward the Window</u>

The following section will demonstrate the technique utilized when the victim is found with their feet pointed toward the window. The firefighter can use one of the previously mentioned drags to get the firefighter to the base of the window.

The inside rescuer will place the victim's feet against the wall with the knees bent, as shown in the photo to the right. Next, the inside rescuer will communicate to the outside rescuer which way the victim will be coming out the window. In this case with the victim's feet toward the window, the inside rescuer will lift the victim's upper body and the victim will come out the window headfirst. The outside rescuer should be prepared to assist with lifting as soon as the victim is within reach.

The inside rescuer will prop the victim up in a seated position as shown in the photo to the right. At that point, the inside rescuer will crouch and get a good grasp on the victim. The inside rescuer will then stand up with the victim as shown in the photo below. Rescuers should use good technique, lifting with their legs and not their back to avoid injury. The goal is to get the victim's hips onto the windowsill; the outside rescuer will help lift as much as possible.



Depending on the size of the victim, the rescuers may not be able to lift the victim onto the windowsill in one smooth motion. If so, the inside rescuer can use one of their knees to hold the victim's weight long enough to allow both rescuers to get a better handhold and lift again. Once the victim's hips are on the windowsill, the rescuers can pivot the victim over the windowsill and out of the building. Communication is critical to ensure the outside rescuer has a firm grasp on the victim to keep from dropping them.

GROUND LADDER RESCUES

- A ground ladder was used to remove 14% of the first 2,000 rescues documented by the Firefighter Rescue Survey. The victim was found on the second floor 30% of the time, the third floor 7% of the time, and a floor greater than the third floor 2% of the time
- Firefighters must be proficient with techniques for removing victims down ground ladders
- When removing victims down a ground ladder, it can be beneficial to have a second ladder beside the first ladder to allow a second rescuer to help manage the victim's weight
- When possible, outside ladder crews should be proactive and place a second ladder next to the initial ladder when a rescue is being performed

Rescuers will drag the victim to the window and lift them out of the window using the techniques described in the previous section. The rescuer on the ladder will place one arm between the victim's legs, and place their other arm under the victim's armpit. Both of the rescuer's hands should be grasping the beams of the ladder, allowing them to slide their hands down as they descend with the victim.

Communication between the inside rescuer and the rescuer on the ladder is critical. The inside rescuer must ensure the outside rescuer has a firm grasp on the victim prior to letting go. The rescuer on the ladder can then descend to the ground and pass the victim off to EMS. When the victim is initially found, it is important for the rescuers to notify the Incident Commander where they will be bringing the victim out of the building. This allows the Incident Commander to direct EMS to that location.

It can be beneficial to have a second ladder and a second rescuer to assist with removing the victim, especially if the victim is large. In the photo to the left, the rescuer on the left side has both arms under the victim’s torso. This rescuer can still grasp the beams of the ladder with both hands to maintain control while descending. The rescuer on the right has one arm under the victim’s waist, and the other arm between the victim’s legs. This rescuer will also grasp both ladder beams while descending.

In these photos, one ladder is a 24’ extension ladder and the other ladder is a 20’ extension ladder. Having ladders with differing lengths is not an issue. It is ideal if the angle of both ladders is the same; the photo above shows how the angle differed between the ladders. However, it is still quite possible to accomplish a successful rescue without both ladders being exactly the same. The most important thing is for multiple rescuers to have immediate access to the victim to allow for a quick rescue that provides the highest chance of victim survival.

SEARCH ROPE DEPLOYMENT

OVERVIEW

- Rope deployment is an incredibly dynamic function that can present a significant challenge to firefighters. It is dangerous to have set in stone rules for rope deployment due to its dynamic nature and the many variables that could affect rope operations
- It would be impossible to cover every possible scenario in which firefighters could potentially deploy rope. In addition, differences in building layouts will present different challenges when firefighters use search rope. Using the same approach each time will not necessarily work
- The goal of this section of the manual is to present a few options demonstrating ways in which rope could be used. The methods demonstrated here are not the only ways to use search rope; any personnel having any additional methods they would like to see added to this manual should contact the JATC office
- For the purposes of this manual, two main uses for search rope will be discussed:
    - Searching Commercial Buildings/Wide Area Search
    - RIT Operations—Searching for a Downed Firefighter
- It could also be necessary for firefighters to use search rope when performing search operations in some large residential homes
- All firefighters need to be proficient in rope operations; do not rely on a rescue or other specialized company to be the only ones proficient at using rope

Click here to view Target Solutions Video on the CFD Rope Bag

ACCOUNTABILITY

- The new 200’ yellow rope bags used by the Division have the apparatus designation printed on the rope bag itself:
  - Rescues—Blue lettering
  - Ladders—Red lettering
  - Engines—Green lettering
- The end of the rope also has an ID Tag on it by the carabiner. Having the ID Tag on the end where the rope is anchored allows other crews to know the designation of the company inside. This can be especially useful for RIT Teams; they can choose which rope to follow if multiple search ropes have been deployed from the same location and a firefighter on one of those crews has called a Mayday
- If the ID Tag is missing, contact Tools and Equipment for a replacement
- The rope has knots every 50 feet that firefighters can use as distance markers. There is one knot at 50 feet, two knots about 4”-6” apart at 100 feet, and three knots about 4”-6” apart at 150 feet. These distance marker knots can help firefighters gauge where they are at on the way out also
- It would be a good practice for crews to take the following steps every time they come to a distance marker knot:
  - Pop a ceiling tile overhead (if present) to ensure there is no fire above or behind firefighters
  - Check each firefighter’s air levels
  - Perform a PAR
- Maintaining crew accountability once inside in a zero-visibility environment can be incredibly difficult, especially if the officer is not familiar with the crew due to having TT’d or OT firefighters
- Using a numbering system for accountability can be a good option, especially for floating officers and RIT Teams made up of multiple crews
- To use a numbering system for accountability, the officer would assign each firefighter a number prior to entry (1, 2, 3, etc.). When the officer calls for a PAR inside, each firefighter states their number. If the officer is part of a 4-person team and hears 1, 2, 3, 4 after calling for a PAR, the officer knows everyone is accounted for
- If multiple crews are married together for rope deployment, keeping one TIC at the front of the group and a second TIC at the back of the group can be a good option. Doing so allows the officers/in-charge firefighters with the TICs to maintain accountability of all the firefighters in the group
- If one firefighter is low on air, it is recommended that the entire crew exits together. A firefighter that is low on air should not be sent back to the exit by themselves

ANCHORING THE ROPE

- The location where the rope will be anchored could vary depending on the structure
- For commercial structures, it is generally a best practice to tie off the rope to an anchor outside the structure prior to entry even if there is moderate visibility inside
    - If firefighters tied off farther inside the structure because they had good visibility initially, worsening smoke conditions could leave the firefighters stranded inside without a rope that actually leads to the outside of the structure
    - Tie the rope to an anchor point outside, even if there is a viable anchor just a few feet inside the doorway. Firefighters may be completely unable to find the doorway if conditions change, even if the anchor point is only a few feet inside the door
    - Anchoring the rope farther inside the structure will also make it very difficult for the RIT Team to locate a specific company's anchor point and follow the rope to find one of that company's downed firefighters in a Mayday situation
    - If there are no usable anchor points outside, driving a tool into the ground and anchoring the rope to that tool could be an option
- In some buildings such as high-rises, it will not be possible to tie off to an anchor outside the structure
    - In these buildings, tie off the rope inside the stairwell if at all possible. Anchoring the rope to a handrail in the hallway inside the door will not allow a completely disoriented firefighter to make it all the way out to the stairwell
    - In high rise operations, firefighters should be aware that if a stairwell door is propped open by the search rope, fire conditions can be significantly affected. Not only does an open door cause a flowpath that could affect fire conditions, it could also cause the entire stairwell to fill with smoke
- If anchoring the rope outside the building to a round object such as a parking bollard, wrap the rope around the bollard in a way that will keep it from dropping to the ground where it is difficult to grab. Options could include using a tensionless wrap or a clove hitch as shown below

Tensionless Wrap

Clove Hitch

ROPE BAG PLACEMENT

- There are multiple ways to carry the rope bag, based on the firefighter's personal preference:
  - Across the body
  - Over the shoulder
  - Arm through the carry handles
  - However else the firefighter finds easiest to deploy the rope
- Across the body with the rope playing out the front of the bag seems to be the most popular method of deployment. Having the rope play out the front of the bag allows the firefighter to reach in with their other hand and pull if the rope gets jammed coming out of the bag
- Occasionally, firefighters using the across the body method may have issues with the bag strap accidentally keying their lapel mic
- During the Mt. Carmel rope training, several crews weaved the SCBA waist strap through the carry handles of the bag. They did not have any issues using that setup, but the rope bag could get in the way of the EBSS (buddy breather) if carried on the firefighter's right side
- Regardless which method is used to carry the bag, the firefighter must be able to manage the rope and keep it taut
- The rope bag firefighter should hold the rope at a height that allows the firefighters following behind to reach out and naturally feel the rope. For instance, if the rope bag firefighter is standing and the rest of the crew is in a 3-point stance, the rope will be too high for them to easily reach
- The strap for the rope bag has a seatbelt buckle allowing for a quick disconnect if necessary. The rope bag firefighter should be sure to have that buckle in a location where it is easily accessible
- Crews should have a discussion at the beginning of their shift and assign a firefighter to be responsible for the rope bag for the entirety of that shift
- The rope bag firefighter should consider carrying a short Z hook to sweep the floor ahead of them as they move
- Having the officer carry the rope bag is generally not recommended. It is difficult to manage the rope, the radio, a TIC, and a tool. Ideally, the rope bag firefighter's only task should be to manage the rope and sweep the floor ahead while moving
- The firefighter carrying the rope bag should call it out every time another distance marker knot is reached (50 feet, 100 feet, 150 feet, etc.)

COMMERCIAL/WIDE AREA SEARCH

- For commercial buildings, the tactics utilized by the search team will depend on the building layout. Is the layout wide open like an airplane hangar? Is it a big box store with distinct aisleways? Is it a Kroger with open areas such as a produce section and aisleways in a different part of the store?
- In a commercial building with defined aisleways, the rope bag firefighter could remain oriented at the main aisle head, with other firefighters moving off the rope to search down each aisle. A professional firefighter should not need a rope to go down a defined aisleway. However, firefighters should stay close enough together that verbal contact can be maintained
- In a grocery store, there may be sections that do not have defined aisleways, such as the produce section, deli section, etc. Firefighters could utilize taglines to ensure they do not get lost while searching these more open areas
- Each crew should size up the building prior to entry, looking for other means of egress besides the door they will be entering through
- Each crew will have to decide where they would like the rope bag firefighter to be positioned. One option is to have the rope bag firefighter in the front, with the officer right behind with the TIC. The officer can reach the TIC over the rope bag firefighter's shoulder to show what is on the screen. The officer can also turn around and scan the rest of the crew with the TIC to ensure they are still accounted for

- Another option would be to have the officer in front of the rope bag firefighter. The officer can scout ahead quickly with the TIC before committing the rope bag firefighter in a specific direction. However, the officer with the TIC will tend to move much more quickly than the rope bag firefighter who does not have the advantage of a TIC. Care should be taken to ensure the officer does not move too far ahead when using this positioning method

COMMERCIAL/WIDE AREA SEARCH CONT.

- One option for crew positioning when doing a wide area search is to have the rope bag firefighter on a wall, with the rest of the crew spread out in a Wing Formation. By doing so, the rope bag firefighter is still oriented on a wall if the rope is lost

- Another option when doing wide area search without a wall present to stay oriented on is the Flying V Formation. This consists of the rope bag firefighter in the center with the rest of the crew split out to each side of the rope bag firefighter in a Flying V

- Firefighters should space themselves close enough together that they can understand any communication. If they can hear the firefighter moving next to them but are not able to hear them communicate, they are probably too far apart. Firefighters can sweep with their tools to ensure no space between the firefighters is missed while searching
- All communication will be passed down the line to each firefighter. The officer can communicate to the firefighter next to them, and that firefighter will pass it on to the next firefighter. Use two-way communication; repeat the message back when spoken to. Doing so can help minimize miscommunication
- If at any point the crew is not sure which way would be the best way to go, the rope bag firefighter could stop and hold the rope tight. Two firefighters could then attach taglines to the mainline and go in opposite directions to scout which direction is best. Once those firefighters return and a direction is picked, the rope bag firefighter would then lead the way again
- Using TICs can be extremely beneficial when dealing with aisles in warehouses or stores. However, if sprinklers are going off, there may be cold smoke present that does not allow the TIC to work as well. It will be more difficult to use TICs in areas with large windows or mirrors because of the reflection issues caused by the glass

RIT OPERATIONS—SEARCHING FOR A DOWNED FIREFIGHTER

- The officer in charge of the RIT Team will need to make the decision on whether to deploy rope, based on the situation
- In a residential structure, there may be some scenarios where the RIT Team Officer chooses not to deploy search rope based on the size of the building, the building layout, and how close the downed firefighter is to an exit. However, the RIT Team officer should be aware that it often takes more than one RIT Team to remove a downed firefighter. Having a rope leading to the downed firefighter can be a huge advantage for a second RIT Team trying to rapidly come in and assist rescue efforts. Deploying a search rope when activated as a RIT Team in a residential structure is recommended in most cases, based on the judgment of the RIT Team Officer
- In a commercial structure where the Mayday firefighter is on an engine company that stretched a hoseline into the building, the RIT Team could choose to follow that hoseline in to find the downed firefighter. The RIT Team should still deploy their own search rope in that situation
- In a commercial structure where the Mayday firefighter is on a ladder or rescue that deployed rope into the building, the RIT Team could choose to identify the Mayday firefighter's crew by using the ID Tag on their rope and following that rope in. The RIT Team should still deploy their own rope in addition to following the Mayday firefighter's rope
- The RIT Team will need to decide where they want the firefighter with the Pak Tracker to be as they move in. The human body absorbs the signal from the Pak Tracker; therefore, it is generally best if the firefighter with the Pak Tracker is near or at the front of the group. The order in which the rope bag firefighter, RIT Bag firefighter, officer, and other firefighters position themselves on the rope is not something that should be set in stone for every situation. The officer and crew may adjust based on the needs of the situation
- Generally, if the RIT Team is moving toward the sound of a PASS alarming or following the Pak Tracker's signal, all the RIT Team members will keep a hand on the rope rather than spreading out in a Flying V or Wing formation. However, the RIT Team officer could decide to have the crew spread out if they are searching a general area for the downed firefighter without the aid of a PASS alarming or a signal from the Pak Tracker. If the whole RIT Team is spread out in a Flying V or Wing formation, it is usually best to have the RIT Bag firefighter just stay on the rope. Searching with a RIT Bag in hand is not very feasible. The decision about whether to stay on the rope or to spread out will be dependent on the situation

SEARCHING FOR A DOWNED FIREFIGHTER CONT.

- In RIT Operations, there may be times where it is best to send a firefighter or officer ahead of the rope bag firefighter to scout which direction to go. The scout would stay within verbal contact of the rest of the RIT Team. Sending a firefighter ahead to scout the direction it sounds like the PASS is coming from can help prevent the rope bag firefighter from committing to the wrong direction and having to backtrack. Backtracking while keeping the rope taut can be difficult to manage. The RIT Officer could choose to move ahead of the rope bag firefighter and use the TIC to scout the area, then have the rope bag firefighter move up to them once a direction is picked
- Once the downed firefighter is found, the firefighter with the rope bag should move just past the downed firefighter and off to the side while still keeping the rope taut. This allows the rest of the RIT Team to find their way in, but keeps the rope away from the downed firefighter to prevent it from getting tangled during packaging or air supply

- If the first RIT Team finds, packages, and removes the downed firefighter, all the rope bag firefighter has to do is move back toward the downed firefighter once the RIT Team is ready for egress, instead of being off to the side. Doing so will bring the rope back within their reach so they can follow it out. The rope bag firefighter must keep the rope taut
- If the first RIT Team runs low on air before being able to remove the downed firefighter, the rope bag firefighter should tie off the rope near the downed firefighter to allow the second RIT Team to easily find that downed firefighter. The first RIT Team should be sure to communicate to the second RIT Team what the location of the downed firefighter is in relation to where the rope was tied off
- When one RIT Team is exiting the structure on rope at the same time that another RIT Team is coming into the structure on the same rope, the two groups should be on opposite sides of the rope to avoid mass confusion when they pass each other. One way to resolve this issue is to have all the firefighters on each RIT Team put the rope in their left hand, or have all firefighters on each RIT Team put the rope in their right hand. Since they are going opposite directions, this will cause the teams to pass each other on opposite sides of the rope

TYING OFF THE ROPE

- In various situations, it may be helpful to tie off the rope inside the structure:
  - Some firefighters like to tie off the rope whenever going around a corner; this keeps the rope from being tight on the inside of the corner. Tying off whenever going around corners is valuable if firefighters have to exit quickly; it keeps firefighters from having to switch sides of the rope multiple times on their way out of the structure
  - Some firefighters like to tie off the rope whenever the direction of travel is changed; this keeps the rope from swinging out over areas firefighters have not yet searched
  - In RIT Operations, the rope can be tied off just past the downed firefighter and off to the side. This allows a second RIT Team to find the downed firefighter quickly if the first RIT Team gets low on air and has to leave
  - The rope and rope bag do not have to come back out with the crew when exiting. Tying off before exiting after a search gives the next crew a point of reference of where the first crew's search ended. Even if the primary search was completed, tying off the rope and leaving it in place can benefit a secondary search team. At the end of the rope bag, there is a locking carabiner that attaches the rope to the bag. This carabiner could be used to tie off the rope if the end of the bag is reached
- Tying off the rope with gloves in reduced/zero visibility will take training to become proficient. Using carabiners makes tying off significantly easier
- The taglines have a total of 8 carabiners (2 carabiners on each tagline bag). These carabiners can be taken off the tagline bags and used for tying off the mainline rope as needed
- One method for tying off the rope has been to tie a knot in the rope, go around an object, and use a carabiner from the tagline to clip the knot back onto the mainline. Some options for tying off the rope could include the following:
  - Figure 8 on a bight
  - Prussic made of rope or webbing
  - Handcuff knot

Figure 8 on a bight

Prussic with rope

TYING OFF THE ROPE CONT.

- A handcuff knot was one of the most effective methods for tying off the rope during the Mt. Carmel rope training exercises. To use this method, tie a handcuff knot in the mainline, wrap the handcuffs around an object, clip the handcuffs together with a carabiner, and pull the slack out. This method keeps the rope tensioned from the tie off point to the original anchor point no matter if slack is given on the working end (Credit to FF Chad Gabriel for this method)
- During the Mt. Carmel training, one of the easiest methods for tying off the rope was to drop a loop through a handrail and clip that loop back onto both ends of the rope with a carabiner. However, this method allows the rope to slack back toward the exit unless it is kept pulled tight the entire time. As a result, this method is not necessarily the best method to use, even though it is easy
- Tying off can use up a significant amount of rope. Based on the Mt. Carmel rope training, tying off at three different changes of direction usually equaled 30-40 feet less of usable rope compared to crews who just hugged the corners instead of tying off
- Being able to tie off the rope is, of course, dependent on there being something to tie off to. Machinery, handrails, poles, structural supports for shelving in aisleways, etc. are all options. Use whatever is available. If there is no tie off point available, making a hole in a wall to use as a tie off point is an option also

Handcuff knot shown above

Prussic with webbing

[Click here to view Target Solutions video on Mt. Carmel Rope Training-Lessons Learned]

TAGLINE USE

- Tagline rope bags should be handed out to each firefighter prior to entry into the building. Trying to hand out the tagline bags inside the building in limited visibility can cause issues
- A firefighter would use the bent neck carabiner on the tagline bag to clip the bag to themselves. Most firefighters clip the carabiner to their SCBA waist strap, shoulder straps, or elsewhere on the SCBA
- The tagline could be used as a scout before committing the mainline in a specific direction
- The tagline can also be used for a firefighter to search a wide area without having to worry about losing orientation to the mainline

- Once a tagline has been deployed, the firefighter has several options for coming back to the mainline. They could disconnect the tagline bag from their body and come back hand over hand along the tagline until they get back to the mainline. The firefighter could also keep the tagline bag attached to their body and coil the tagline rope while coming back to the mainline. This can be quite difficult to do with a tool in hand; the firefighter could consider holstering their tool in their SCBA waist belt to allow both hands to be free

- The tagline carabiner will slide if it is just clipped to the mainline. Tie a handcuff knot, figure eight on a bight, butterfly knot, slip knot, or another knot in the mainline and hook the tagline to that knot. Be aware that a tight, restricting knot would make it difficult to unclip the carabiner when the firefighter returns to the mainline. If a handcuff knot is used, just hook the tagline carabiner to both loops of the handcuff knot as shown on the right. An additional option could be to have a second firefighter hold the carabiner on the mainline to keep it from sliding

TAGLINE USE CONT.

- If a tagline is tied off to a knot on the mainline, the rope bag firefighter should not be too far ahead of the tied off point to keep the crew from separating too far apart
- In an apartment building with a center hallway, firefighters do not need to use a tagline to go off the center hallway into an apartment. A firefighter could search the apartment without rope while another firefighter stays oriented with the rope in the hallway by the front door of the apartment
- Some crews like to use a pendulum method for searching wide areas with mainlines and taglines. To use this method, attach the tagline to a fixed point on the mainline using one of the previously mentioned knots. The firefighter with the tagline would then move sideways away from the mainline until the tagline is fully extended. The firefighter would then move forward or backward like a pendulum swinging back and forth. Once one area is searched, the tagline firefighter would move farther along the mainline and repeat the process
- Depending on the building layout and obstacles present, taglines can get tangled up or wrapped around objects pretty easily. If necessary, the firefighter has the option of moving back to the mainline, disconnecting the tagline completely, and leaving it in the building

ADDITIONAL CONSIDERATIONS

- Firefighters should look at floorplans prior to entry into the IDLH environment if possible. Some commercial buildings may have marked floorplans at entrances. Taking the floorplan off the wall and carrying it with during the search could be an option also. In residential high-rise buildings, firefighters could look at the floor below the fire floor. It will likely have a layout similar to the fire floor itself
- Moving while standing versus using a 3-point stance is situation dependent. If visibility allows, move while standing. However, if firefighters cannot see their own feet, they should be down in a 3-point stance. While firefighters may have little reason to be concerned about falling through a concrete floor in a commercial building, that does not mean there are no other hazards present, such as mechanical pits
- Pits in the floor can be a significant hazard. Even if firefighters did not encounter a pit on their way into a structure, the rope could have swung over a pit without them realizing it when they changed direction inside the building. It is essential that firefighters still sweep the floor ahead of them as they exit. If firefighters encounter a pit on the way in, they could consider tying off the rope away from the pit to keep the rope from swinging over the pit at any point as they move through the building

ADDITIONAL CONSIDERATIONS CONT.

- If a crew using rope decides to change directions and backtrack toward where they entered, it will be necessary for the rope bag firefighter to coil rope to keep it taut. This can be quite difficult to do with a tool in hand. Consider placing hand tools in the SCBA waist strap if both hands are needed for rope management
- When popping ceiling tiles to check conditions above the drop ceiling, be aware that the ceiling tiles may have smoke heads, speakers, or other objects attached to them. If that ceiling tile drops to the ground with wires trailing back up toward the ceiling, it can create an entanglement hazard
- When moving through a commercial layout that has multiple sets of fire doors, firefighters may run out of their personal door chocks quickly. Firefighters could use their tool to prop open a door while searching a room. Some firefighters pulled ceiling tiles down and shoved them under the door to use as a chock (Credit to FF Mark Siemer for that idea)
- If firefighters following a search rope need to move to the other side of the rope for any reason, firefighters must be aware that trying to move under the rope can cause the rope to get tangled on the firefighter's helmet, mask, SCBA, etc. If trying to move under the rope, firefighters will have to lift the rope high over their heads. A good option when needing to switch sides is to have everyone stop, have the rope bag firefighter lower the rope toward the ground, and have any firefighters needing to switch sides move over the rope. The rope bag firefighter can then raise the rope back to normal height and continue on

- If firefighters go 200 feet into a building and reach the end of the rope bag, they could, in theory, use taglines to extend off the end of the mainline. However, this would generally not be recommended. If firefighters are 200 feet in, it is likely they are already low on air or will be low very soon. Rather than go more than 200 feet into a building, firefighters could do recon and attempt entry from a different point that would provide more direct access to their objective
- It is a very dangerous situation if a firefighter loses contact with the rope and the rest of their crew. It may be possible for a lost firefighter to feel expansion joints in a concrete floor and follow that to an exterior wall. Another option for lost firefighters is to follow a floor drain if they can locate one

ADDITIONAL CONSIDERATIONS CONT.

- When packing the rope bag after deployment, set the bag on end and pack the bag from the deployment end. Firefighters can either use two hands as shown in the photo on the right, or the zipper can be opened slightly and the firefighter can reach in the bag with one hand pulling the rope into the bag while pushing it in with the other hand. Pack the bag from the bottom up and coil the rope around like a spring. Do not set the bag horizontally with the zipper open and stuff it from one end of the bag to the other end. The first part of the rope that deploys out of the bag should be the last part of the rope that got packed into the bag
- **If you do not manage the rope, it will manage you!**

VENTILATION FUNDAMENTALS OVERVIEW

TRUCK OPERATIONS MANUAL

SECTION TOPICS

Ventilation Fundamentals Overview	**Mechanical Ventilation**
Ventilation Size-Up Factors	**Positive Pressure Ventilation**
Types of Ventilation	**Negative Pressure Ventilation**
Horizontal Ventilation	**Hydraulic Ventilation**
Natural Ventilation	**Vertical Ventilation**

SECTION OBJECTIVES

Identify size-up factors pertaining to ventilation	**Understand how to perform Positive Pressure Ventilation**
Define and understand Horizontal Ventilation	**Understand how to perform Negative Pressure Ventilation**
Define and understand Natural Ventilation	**Understand how to perform Hydraulic Ventilation**
Define and understand Mechanical Ventilation	**Define Vertical Ventilation**

VENTILATION FUNDAMENTALS

OVERVIEW

This section of the manual was designed to help the Columbus Firefighter review basic ventilation techniques and apply them to specific building types. When performed correctly, the removal of smoke, heat, and gases and the introduction of cool, oxygen-rich, fresh air will aid the overall success of any fire attack. Whether performing search and rescue, fire attack, or any additional task on a fireground, firefighters who cannot see or operate due to heat will struggle to successfully perform their assigned tasks.

CONTENT

- Ventilation Size-Up Factors
- Types of Ventilation
    - Horizontal Ventilation
    - Natural Ventilation
    - Mechanical Ventilation
        - Positive Pressure Ventilation
        - Negative Pressure Ventilation
        - Hydraulic Ventilation
    - Vertical Ventilation

VENTILATION SIZE-UP FACTORS

PRE-ARRIVAL CONSIDERATIONS

- As soon as the alarm is dispatched, the size-up begins
- Even before getting to the truck, firefighters should ask themselves if the dispatched address is familiar to them
  - Is this area residential or commercial? Is it a high hazard area?
- What do the comments on the MDC say?
- More importantly, what is burning?
  - Food on the stove?
  - Room and contents fire?
  - Structure fire with multiple calls?
- Each type of fire or any additional information provided should help firefighters establish their initial plan of action. For instance, food on the stove could indicate a need for positive pressure ventilation if more smoke is present than what can be cleared by just opening a window
- What is the response time to the scene? What will the arrival order on scene be?
- What are the weather conditions?
  - Snow, rain, or icy conditions may make vertical ventilation difficult
  - High wind conditions will further emphasize the importance of correctly identifying tactical windward and leeward positions
  - Wind driven fire events can progress rapidly and be extremely dangerous. It is important to recognize these conditions early in the incident

WHAT DO YOU SEE ON ARRIVAL?

- Getting an overall picture or view of any incident that might involve ventilation is important because it helps firefighters form a mental plan for their tactical approach. This is where a scene size-up comes into play
- The following are some size-up factors to consider:
  - Location of the fire
  - Location of possible victims
  - Smoke conditions
  - Access profile
  - Flow path considerations
  - Fire dynamics
  - Level of involvement—is the building partially involved or fully involved?

BUILDING CONSTRUCTION

- The type of construction will certainly play a key role in determining what type of ventilation to perform
- The next two pages will illustrate how the building construction type can affect the method of ventilation chosen

Type I—Fire-Resistive: Consists of walls, columns, beams, floors, and roofs made of non-combustible or limited-combustible materials. Susceptible building elements are protected with fire resistive material if needed. Ventilation will typically be limited to natural openings, bulkhead doors, and taking over control of built-in HVAC systems.

Type II—Non-Combustible: Similar to fire-resistive construction because the walls, floors, and roof support system including the roof deck are all made of non-combustible material. However, steel building components will not be protected. Large open areas are common. Non-combustible structural materials are used, such as a metal deck roof and steel bar joists.

Type III—Ordinary Construction: Non-combustible exterior walls, with compartmentalized interior spaces smaller than Type II. Interior walls and floors are primarily constructed of wood.

Type IV—Heavy Timber: Exterior walls are made of masonry material. Interior walls, floors, and roof material consist of large dimensional lumber.

Type V—Wood Frame: Consists of numerous different construction types, such as Brace Frame, Platform, Balloon Frame, and Lightweight construction. Exterior walls, interior walls, floors, roofs, and other structural members are typically made of wood.

RESCUE POTENTIAL

When looking at the building to determine ventilation size-up factors, firefighters should also be sizing up life safety factors. What is the victim survivability profile of the scene? Is there a known life hazard? Is there viable space inside the structure that could contain a person? Will firefighters be attempting a search through a second-floor access point? Firefighters must remember that any access point becomes either an air intake or a vent point for the fire and changes the fire dynamics of the structure.

TYPES OF VENTILATION

OVERVIEW

- The type of ventilation firefighters choose to perform is based on more than just the size-up factors listed previously. Other factors to consider include visual indicators of how the fire is or is not progressing, fire extension, how effective the engine's hand line is, the interior engine crew's location, and how fast they are pushing toward the seat of the fire
- On non-emergency or service runs, the type of ventilation firefighters choose is based on what areas need to be vented and the best path for that atmosphere to take

VENTILATION METHODS

- Horizontal Ventilation
  - Natural Ventilation
  - Mechanical Ventilation
    - Positive Pressure Ventilation (PPV)
    - Negative Pressure Ventilation
    - Hydraulic Ventilation
- Vertical Ventilation

HORIZONTAL VENTILATION

DEFINITION

- Horizontal ventilation refers to the removal of smoke and heat in a horizontal direction from side to side or from front to back of a structure
- The most common type of horizontal ventilation occurs in residential structures and usually involves a one or two bedroom and contents fire, or smaller incidents such as food on the stove. Often the existing ventilation openings, doors and windows, have already established a flow path, which is why the initial start of ventilation is so important
- Horizontal ventilation can be broken down into different ways firefighters can ventilate, or the process with which firefighters can start moving an IDLH atmosphere out of the structure
  - Natural Ventilation
  - Mechanical Ventilation
    - Positive Pressure Ventilation
    - Negative Pressure Ventilation
    - Hydraulic Ventilation

KEY POINTS TO REMEMBER ABOUT HORIZONTAL VENTILATION

- Can be a quick way to clear smoke and heat, which can help the engine crew with hose advancement and fire suppression by increasing visibility and decreasing temperatures
- Stay in coordination with the engine crew. Always know where they are and where they are going
- Nondestructive horizontal ventilation can happen quickly and efficiently by opening up doors and windows as firefighters move along an interior search path or when searching for the fire
- Outside ladder crews can also vent by trying before prying on doors and windows as they perform their outside responsibilities
- Forcible entry techniques can be used for ventilation by forcing a door or breaking a window with hand tools or a ground ladder
- **REMEMBER—**If firefighters force a door or break a window, it will be very difficult to control the opening. Once a window is gone, it is gone. Firefighters need to ensure they understand wind conditions and the flow path when making ventilation decisions
- Ventilate what needs to be vented. Do not get caught up smashing windows out for no reason. If there is fire and smoke on the first floor, start there. Do not create openings above the fire too early. Conversely, do not vent under or behind interior crews

NATURAL VENTILATION

DEFINITION

- Natural ventilation is using the wind and air currents outside the structure to remove products of combustion from within the structure
- Many times, this type of ventilation is utilized quickly on fire runs during the initial stages of fire suppression

KEY POINTS TO REMEMBER ABOUT NATURAL VENTILATION

- The effectiveness of natural ventilation will depend largely on the wind direction and the available openings of the structure
- For natural ventilation to be effective, **at least two openings are needed**:
    - At least one opening on the windward (up-wind) side of the structure
    - At least one opening on the leeward (downwind) side of the structure
- Ideally, the larger opening should be on the upwind/windward side, and the exhaust opening, most likely windows, should be on the downwind/leeward side
- These openings can be obtained by various means of forcible entry or nondestructive forcible entry
- Natural ventilation <u>can</u> be performed with only one opening, such as opening a kitchen window for burnt food on the stove. However, the opening must be on the leeward side of the structure, and it will not be as effective
    - If a single exhaust point is opened up on the windward side of the structure, the wind will not allow products of combustion to be released from the structure

MECHANICAL VENTILATION

DEFINITION

- Think of mechanical ventilation as a form of natural ventilation that firefighters have complete control over by using powered equipment
- With mechanical ventilation, firefighters control where the wind comes from and how fast the wind moves into or out of a structure
- Mechanical ventilation can be accomplished using any of the options below:
    - **Positive Pressure Ventilation**
    - **Negative Pressure Ventilation**
    - **Hydraulic Ventilation**
- Powered by electricity, fuel, and now even batteries, fans are an important piece of equipment that can be used to clear compartments of smoke. The electric RAM fan, gas powered fan, and smoke ejectors (box fans) can all be used. For more detailed information and product specifications on these fans, refer to the Equipment section of this manual or read the individual equipment manufacturer's manual
- Firefighters can also use air currents created by a specific type of water stream flowing from a hand line. By using a handline to flow water out of a window using a fog pattern, firefighters are able to create a current of air, which pulls smoke and heat out of the room when used correctly

POSITIVE PRESSURE VENTILATION

OVERVIEW

- CFD's larger fans, most commonly the RAM fan, are used to introduce fresh air into a structure. The idea is to create a positive pressure environment within the house by forcing air into the structure
- Once the structure is positively charged, firefighters can then dictate the removal of smoke, heat, and other fire gases by opening and closing separate exhaust points within the structure
- For this technique to be effective, firefighters must introduce fresh air from an opening (usually a door) and use a smaller exhaust point (usually windows)
- It is important that the exhaust opening be smaller than the entry point, or firefighters will never be able to keep a positive pressure environment in the structure. This technique works best when every window has not been broken out
- Ideally, firefighters should try to exhaust the smoke and heat from the area or room closest to the fire first, then work their way through the remaining area of the structure
- For example, consider a typical two-story wood frame single family residential fire. Crews get the fire knocked down on the first floor as the ladder team finishes throwing ground ladders and running lights to the interior crews. The outside ladder team hears the "Water on the Fire" benchmark and starts thinking about bringing the fan up to the front door. After being ordered to start ventilation by the interior officers or the IC, switch the fan on and start to push air into the structure. At this point, the outside ladder crew should communicate with the interior crews to have them open up a window or rear door to give the smoke somewhere to vent
- Remember that CO must be monitored when using a gas-powered fan for positive pressure ventilation

ENTRY POINT

- The fan is usually placed at larger openings such as a doorway. A good starting point is about 4-6 feet away from the door. Most importantly, firefighters want the cone pattern of moving air to cover the complete opening, even in the corners
- The position and distance of the fan might have to change to achieve the placement of the cone pattern over the entire opening. Firefighters can confirm this by watching the smoke. If there are any void spaces, some smoke might be seen creeping out of the opening

ENTRY POINT CONT.

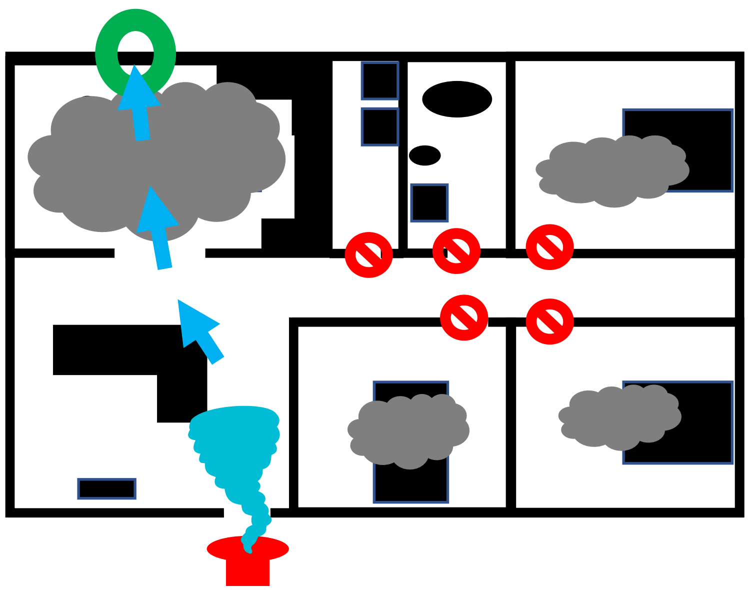
- Another way firefighters can check fan placement is to feel for air in the corners with their hand, or find something light on the scene like a piece of cloth that can be used to check the air current
- Firefighters should remember to consider the wind direction and speed; do not try to overpower Mother Nature by going against the wind direction. If this happens, try to find a different entry opening to use

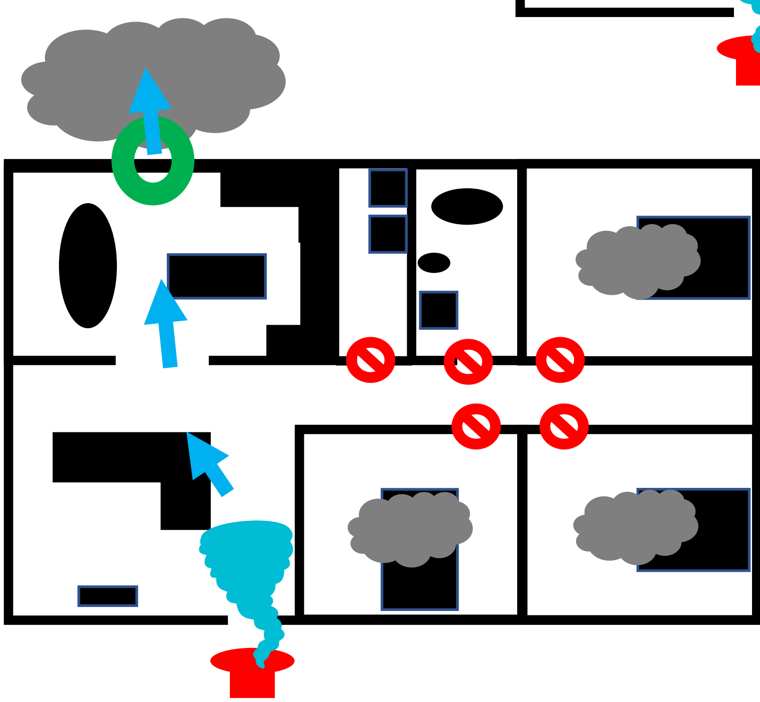
EXIT POINT

- What window or door should be opened to create the exit point?
    - A smaller opening than the entry point, or at most the same size opening, is the most efficient and preferred option
- Location of the exit point will be determined by how firefighters want the smoke to travel
- Firefighters should vent the greatest area of concern first and remove the byproducts of combustion as quickly as possible
- Finding an exit opening close by will help remove the smoke quickly. It is important to make sure all the right windows, doors, and hallway doors are closed before or soon after the fan is started
    - Consider this scenario: there is smoke on the first floor and the second floor is clear, but all the second-floor bedroom windows are open. If the fan is started, where will the smoke go?
    - In this case, make sure the upstairs is as closed off as it can be. Next, exhaust the smoke out of the first floor somewhere to keep from pushing any more smoke upstairs
    - After the first floor is clear, recheck the upstairs for lingering smoke. Any smoke on the second floor can be pushed out a second-floor exit opening after closing the first-floor exit opening
- Now imagine there is heavy smoke on the second floor, and the first floor has some hazy smoke. Crews get windows opened throughout the house and start the fan. Will crews be able to get positive pressure in the structure? Probably not. To get enough pressure to push smoke out the second floor, firefighters would have to close up the first floor. These are some of the things firefighters must consider when performing positive pressure ventilation on the fire ground

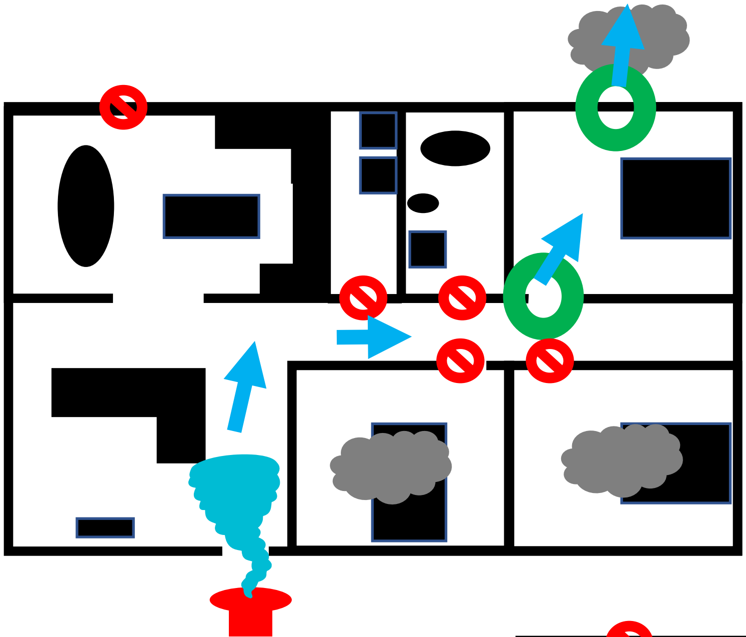
This example shows a single-story residential structure with a kitchen fire. The photo on the left shows the fan moved into position at the front door. Note that the fan **__is not started__** until interior crews get water on the fire and request ventilation.

The photo on the right shows that the interior crews have requested ventilation and the fan has been started. To control the flow of smoke throughout the structure, crews have opened the kitchen window and closed all other doors to adjoining parts of the home. **Notice the entry point (front door) is larger than the exit point (window).**



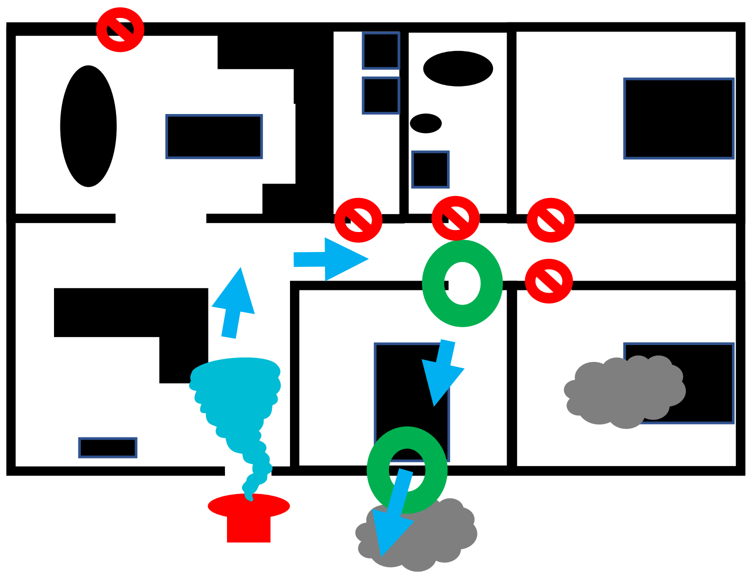


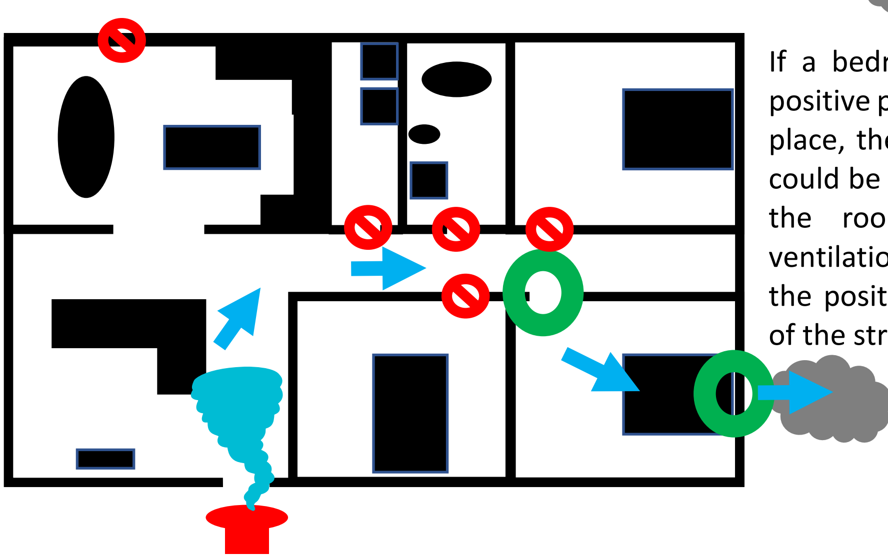
The structure will quickly develop a positive atmosphere as long as a seal is maintained around the front door as described previously. Smoke and byproducts of combustion will be pushed from the structure. Ventilate the worst atmosphere first; in this case that would be the kitchen. The bedrooms only have residual amounts of smoke from the extinguishment efforts.



After the kitchen is ventilated, the residual smoke can be removed from the bedrooms (photo on the left). After closing the kitchen window, crews systematically open one bedroom door and one bedroom window at a time. This will force the positively charged atmosphere to clear the smoke and byproducts of combustion from each bedroom.

Notice how crews isolate an area after completing ventilation in that area. If all doors and windows are left open, it will be nearly impossible to maintain a positive atmosphere; smoke removal will take longer and be less efficient. For example, if the kitchen window were left open while trying to remove smoke from the bedrooms, it will be difficult to get enough airflow down the hallway to remove the smoke.





If a bedroom door is closed while positive pressure ventilation is taking place, the window to that bedroom could be left open to try to ventilate the room with passive natural ventilation. Since the door is closed, the positive atmosphere in the rest of the structure is not affected.

NEGATIVE PRESSURE VENTILATION

OVERVIEW AND KEY POINTS

- As the name suggests, negative pressure ventilation is the opposite of positive pressure ventilation. Instead of forcing fresh air into the structure, firefighters are drawing the byproducts of combustion out of the structure by using smoke ejectors (box fans)
- Mostly used in basement fires with the box fan in a basement window to draw trapped smoke out of the structure. If done correctly, this tactic can assist tremendously at a basement fire
- Negative pressure ventilation can be used in conjunction with positive pressure ventilation to expedite results. For example, at a basement fire a PPV fan could be used to positively charge the first floor with the door to the basement open. Using negative pressure ventilation in a basement window at the same time can pull air through the structure more quickly
- If there is an open area, firefighters can use negative pressure ventilation to assist the natural ventilation if the air currents are right
- It is difficult to get the most out of this ventilation technique because the opening needs to be completely sealed around the fan for it to draw an effective negative pressure; most times firefighters simply do not have the time nor the resources to set that up
- If any of these fans do get used at any incident and smoke has been ejected through them, the fans must be cleaned because they get dirty quickly

HYDRAULIC VENTILATION

OVERVIEW

- Hydraulic ventilation, while not commonly used on company, can be effective if done correctly and at the right time
- By using a water stream in a fog pattern and directing it out of an opening, firefighters can create a pressure difference behind the stream. This causes smoke and air to be drawn to the stream and out the window

KEY POINTS TO REMEMBER ABOUT HYDRAULIC VENTILATION

- The fog pattern should cover approximately 80-90% of the window opening. This will allow the maximum amount of air to be entrained into the stream exiting the structure
    - It is important to make sure the corners of the window or opening used are left open and not obstructed by the water stream. These areas will allow products of combustion to exit the structure
- Note—this technique can be used with a gated down smooth bore nozzle; however, it will be less effective than when a combination nozzle is used

HYDRAULIC VENTILATION CONT.

- Hydraulic ventilation is most effective immediately after fire suppression when a room needs to be vented. The engine crew, or whoever is on the hand line, can quickly ventilate the room by using their hose stream. Below are a few things to keep in mind:
    - Firefighters should always look out the window from which they are about to flow water. The last people the interior crews want to hit with water are the Battalion Chiefs who are still studying the structure
    - Be mindful of weather conditions and what is on the other side of the opening water will be flowing from. If it is below freezing outside, firefighters may not want to flow a large amount of water outside the structure that could cause slippery conditions for outside crews. Other ventilation techniques would be preferred in those cases

VERTICAL VENTILATION

OVERVIEW

- Before getting into the tactical operation and technical process of vertical ventilation on various different types of structures, the importance of understanding that the techniques shown in the next section are just a few examples of techniques used around the city must be expressed
- Please note the importance of talking to and training with the company officer and assigned personnel at your station; train and practice what works for your crew. All that matters is completing the objective of accomplishing ventilation safely, quickly, and efficiently
- **<u>Full PPE and SCBA should be worn at all times while performing vertical ventilation</u>**

DEFINITION

- Vertical ventilation is defined as the removal of fire, heat, and byproducts of combustion vertically out of a structure
- This is typically completed by using one of the following methods:
    - Opening the natural ventilation openings on the structure (bulkhead doors, shafts, or scuttle hatches)
    - Cutting the roof
- <u>The next section, Roof Operations, will discuss in more detail the actual process for performing vertical ventilation</u>

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ROOF OPERATIONS

TRUCK OPERATIONS MANUAL

SECTION TOPICS

Roof Operations Overview

Types of Roofs

Roof Pitches

Helpful Roof Tips

Residential Vertical Ventilation

Residential Louver—Roof Ladder

Residential Louver—Aerial Ladder

Commercial Flat Roof Ventilation

SECTION OBJECTIVES

Understand how to recognize various types of roofs common in Columbus

Define roof pitch and understand how it affects roof operations

State the equipment needed to perform residential vertical ventilation

Understand where to cut a roof in relation to wind direction

Understand the process for ventilating a roof from a roof ladder

Understand the process for ventilating a roof from an aerial ladder

State the equipment needed for commercial flat roof ventilation

Understand the process for ventilating a commercial flat roof

ROOF OPERATIONS

OVERVIEW

- Roof Operations can be a complicated task with many variables
- This section of the manual is not designed to cover every possible aspect of Roof Operations. It is simply meant to serve as an introductory guide to some of the more common scenarios that may be encountered within the City of Columbus
- <u>Vertical ventilation has to be the mindset of first arriving Ladder Companies. It can always be scaled back. However, if interior companies call for it and ladder crews are not already working to accomplish it; it is too late! **Preparation, planning, and mindset are crucial**</u>

CONTENT

- Types of Roofs
- Roof Pitches
- Helpful Roof Tips
- Residential Vertical Ventilation
  - Residential Louver—Roof Ladder
  - Residential Louver—Aerial Ladder
- Commercial Flat Roof Ventilation

TYPES OF ROOFS

ASPHALT SHINGLES

FREQUENCY: By far the most common roofing material in the City of Columbus.

HAZARDS: Can deteriorate and degrade over time, creating slippery roof conditions. Moss, wet leaves, and other organic material on the roof should not be walked on directly. Crews should use a roof ladder or aerial ladder when such conditions are present.

CONSIDERATIONS: Ability to walk directly on the roof will be determined by the pitch of the roof and the conditions present.

CUTTING: Chain saw is the common tool of choice. Hand tools such as a Pig or Axe can also be used if the saws fail, or if conditions are too smoky for the saws to run.

SLATE

FREQUENCY: Can be found frequently in older homes, especially on the inner North, South, and East sides of the city.

HAZARDS: Slate should never be walked on directly. The slate shingles are typically secured via predrilled holes using one or two nails that are prone to fracturing. Falling slate is also extremely sharp and heavy in comparison to asphalt shingles.

CONSIDERATIONS: Due to the weight of the slate roof, sheathing will commonly be constructed of rafters and plank decking.

CUTTING: A carbide tip chain saw should have no problem cutting through slate in normal circumstances. If problems arise, firefighters can then transition to a circular saw or break the slate with a striking tool to reveal the wooden decking material below it.

CLAY TILES/TERRACOTTA

FREQUENCY: Also found in the inner North, South, and East sides of the city.

HAZARDS: The tiles can become brittle as they age and are exposed to the elements. Crews should avoid walking directly on the tiles if at all possible, especially if a steep pitch is present. Clay tiles are heavy; falling tiles are a hazard if dropped or broken.

CONSIDERATIONS: Tiles are usually secured to furring strips placed over wooden roof sheathing. Typically, only the first few rows are nailed to the furring strips, and the top row cap is secured with mortar. The remaining middle rows are held in place by the weight of the subsequent rows above them.

CUTTING: Tiles should either be removed by hand or broken with a striking tool to reveal the sheathing below. If removing the tiles by hand, lift them up and stack them off to the side of the desired hole location. Once the wood sheathing is exposed, the tool of choice to cut with is a chain saw.

RESIDENTIAL METAL

FREQUENCY: Becoming more common throughout the city, especially in rehabbed homes.

HAZARDS: The metal roof panels can hide structural compromise, in addition to making it hard to find the exact location of the fire below. Metal roofs can also trap more heat inside the structure, leading to more dangerous conditions and reduced flashover times.

CONSIDERATIONS: Metal deck material is commonly secured to stringers/purlins that run horizontally across the roof. The metal pieces are usually about 3' wide by the length of the roof (ridge to eave line). The stringers/purlins can be placed directly on the roof sheathing, or on top of a pre-existing shingled roof. Because of this, it is important to remember the cutting depth needed to cut through the metal decking, void space, and the roof sheathing material.

CUTTING: Can be cut with a chain saw due to its lightweight nature. However, a circular saw may be preferred. Remember, traditional circular saw composite metal blades may work, but the blade cut depth will decrease as the material from the blade wears down.

COMMERCIAL METAL

FREQUENCY: Found throughout Columbus. Common at large metal frame warehouses and smaller commercial shops, such as automobile workshops and mechanic shops.

HAZARDS: Just like residential metal roofs, the commercial metal roof panels can hide structural compromise and make it hard to find the exact location of the fire below. Metal roofs can also trap more heat inside the structure, leading to more dangerous conditions and reduced flashover times.

CONSIDERATIONS: Unlike residential metal, commercial metal roofs are often secured directly to the metal truss system below. These truss systems will typically be wider spans. However, they can also be affixed with stringers/purlins attached to pre-existing roof structure.

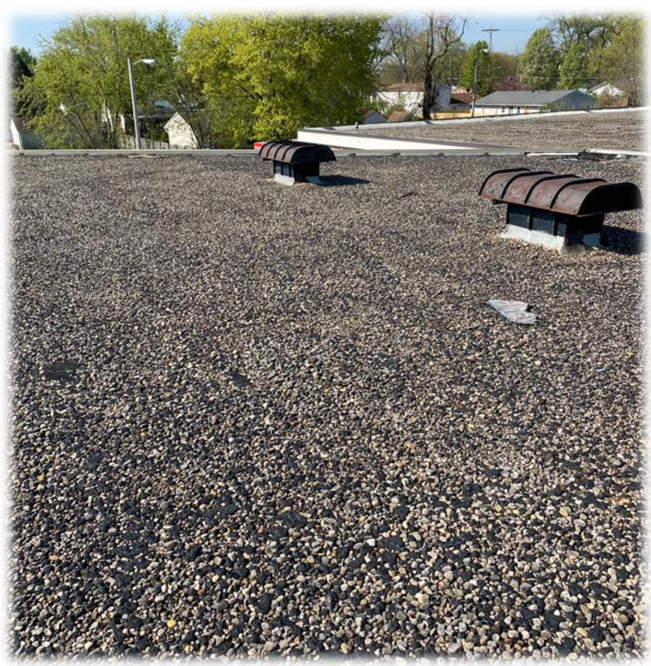
CUTTING: Due to the thicker gauge of commercial metal material, a circular saw is preferred. Traditional composite metal blades may work, but the blade cut depth will decrease as the material from the blade wears down.

GRAVEL AND ASPHALT COMMERCIAL

FREQUENCY: Common roofing method found throughout the city.

HAZARDS: The numerous layers of built-up tar and asphalt can create an increased dead load on the building's structural components. This fact, combined with wider truss spans and truss orientation, are of particular concern to firefighters. This type of roof can be extremely labor intensive to cut due to the numerous built-up roof layers above the metal decking.

CONSIDERATIONS: A lack of upkeep and constant heat from the sun can cause the gravel, tar, and asphalt to melt together and form an extremely hard top layer over time. A large number of saws may need to be committed to vent this type of roof because they will be worn down and gummed up quickly. Numerous layers of material are required to properly weatherproof the structure, which is why they are sometimes referred to as built up roofs (BUR). Time, fatigue, and staffing should be a consideration when determining ventilation tactics.



CUTTING: The layers of asphalt, tar, and foam insulation can be removed with the chainsaw; the circular saw will be needed on the metal decking underneath. If the gravel cannot be shoveled out of the way before cutting, a circular saw may also be needed to remove the layers of insulation, asphalt, and tar. A DAX or diamond blade is preferred.

SINGLE PLY

FREQUENCY: Due to advancement in materials, quicker installation, and more cost-effective methods, these roofs are becoming the preferred type of commercial flat roofs.

HAZARDS: Common materials used in single ply roofing such as thermal plastics or synthetic rubber EPDM (Ethylene Propylene Diene Monomer) are flammable, and their byproducts of combustion are extremely toxic. Fire can also travel in the void space above the roof decking and below the single ply material.

CONSIDERATIONS: While there are a variety of different materials that are used in single ply roofing, most of the materials can be cut and removed with a razor blade knife or chain saw. It is much easier to expose the metal decking underneath than on an asphalt and gravel roof.

CUTTING: A chainsaw or razor blade can be used to remove the single ply material and expose the metal decking below. The metal decking should be cut with a circular saw; a DAX or diamond blade is preferred.

SOLAR PANELS

FREQUENCY: Becoming more common all over the city; can be found on both residential and commercial occupancies.

HAZARDS: In addition to added dead load weight on the structure, solar panels pose an obvious electrocution hazard to crews. There are many different makes and manufacturers of solar panels. Most systems have a variety of different shut off or isolation switches present. Due to their complex nature, crews should avoid solar panels whenever possible. Even if the switches are shut off, the panels themselves can still remain live.

CONSIDERATIONS: Solar panels present a unique and complex hazard to fire crews. Information from the homeowner and electric companies on scene can be an extremely valuable resource. Most homes will have a main power switch to kill the power from the roof to the home. However, this does not account for any backup forms of power, such as generators.

CUTTING: If vertical ventilation is needed, look for other openings in the structure such as skylights, roof access hatches, etc. If none are available, ventilate another section of roof that is safely away from the solar panels. Firefighters should never attempt to cut through the solar panels.

RAIN ROOFS

FREQUENCY: Can be found on older roofs, both residential and commercial.

HAZARDS: Rain roofs can present a confined space hazard for crews. Crews should never cut the top level of a rain roof and enter the void area between the old roof and the new rain roof.

CONSIDERATIONS: A rain roof is simply a new roof assembly built directly on top of an old one. Traditionally, rain roofs are built when older flat roofs begin to leak and have issues. Instead of replacing the pre-existing flat roof, building owners will construct a new pitched roof assembly over top of the old roof. Without prior knowledge of the building from inspections or training, it will be hard to know these roofs are present before firefighters are on top of the roof attempting to ventilate. The rain roofs add a structural load to the building that it was not originally designed for.

CUTTING: The ability to vertically ventilate will largely depend on the distance between the new roof and the old. If the distance to the old roof is small and it can be reached from the top roof, firefighters can ventilate it accordingly with the appropriate saw. Traditional vertical ventilation will most likely be limited. Crews should look for other openings in the structure such as skylights, roof access hatches, etc.

ROOF PITCHES

WHAT IS ROOF PITCH?

- Roof pitch is defined as the angle or slope of the roof
- Roof pitch is commonly referred to as a ratio with two numbers representing the amount of incline or decline in a 12-inch distance
    - For example, a 4/12 pitched roof means that for every foot (12 inches) of distance traveled the roof moves up/down 4 inches

CONSIDERATIONS

- Recognizing the pitch of a roof is an important step in the tactical decision-making process
- Steeper roofs require more planning for the crews assigned to vertical ventilation
    - If the roof is solid and not weakened by fire, can firefighters handle walking on the pitch of the roof without a roof ladder?
    - Are the pitches extremely steep? Will firefighters need to cut from an aerial ladder?
- A roof pitch that firefighters felt comfortable walking on prior to ventilation may become more slippery after fresh sawdust from the cut is flung over the roof
- Weather conditions must be taken into account. Whenever snow is on the roof, think about using a roof ladder
- When looking for footholds or extra support, use the valleys of the roof. Valleys are formed when two different roof slopes meet
- Moss growing on a roof creates an extremely slippery roof condition, even on less severe pitched roofs
- Regardless of the roof pitch or construction, firefighters will always be provided more support from an aerial ladder

HELPFUL ROOF TIPS

OVERVIEW

- This section highlights a few useful tips for firefighters assigned to the roof at a fire scene
- Although each fire run and rooftop are different, the goal of this section is to stimulate discussion among firefighters and lead to sharing of other experience-based tips

CROSS IN THE FRONT

When operating on the roof of multiple attached buildings such as strip malls or taxpayers, firefighters should understand that although the front of each building may share a common face (A side), the rear of each individual occupancy may not be the same depth (front to back). Because of this, it is always safer to cross over from one roof to another using the front of the building. Smoke from the fire may limit visibility, and attempting to cross from one roof to another in the rear could result in crews falling off the roof. Also, the roof typically slopes down toward the rear. By crossing in the front in slippery conditions, firefighters have more time to recover if they trip and fall; they can plunge a tool into the roof or grab anything that could slow their fall. This photo shows a row of businesses at the corner of Parsons and Marion that share a common face (A side), but have uneven depths from the front to the rear.

PLUNGE CUTS

Ventilating a residential roof typically requires numerous tools and has different steps to the process as shown in the next section. When not using the chainsaw, a plunge cut can be used to keep the saw from sliding down the roof. Firefighters can just bury the bar of the chainsaw up to the bumper spikes as shown in the photo on the right. This holds the saw in place and frees up the firefighter's hands, allowing them to focus on the task at hand instead of worrying about the saw sliding off the roof. When using this method, firefighters must be mindful of conditions under the saw. Do not plunge cut the saw if there are heavy fire conditions directly underneath that could damage the saw.

FOOT HOLDS

Most fire textbooks mention driving the pike end of a Halligan into the roof to create a foothold when operating on pitched residential roofs. Although that is effective, the halligan serves little other purpose when operating on a roof. Instead, consider using the pike pole as a foothold. The pike pole is already needed for ventilation and is also longer, providing more flexibility when selecting the location of the foothold. Any part of the hook can be used. This photo shows crews spearing the chisel end of the New York Hook through the roof to create a foothold.

SOIL STACKS

Soil stacks are commonly made of plastic PVC. Because of this, they will typically begin to show signs of heat prior to any metal stacks present. Keep a watchful eye on these plastic pipes; signs of discoloration or melting are a great way to help locate the fire below.

HVAC STACKS AND OTHER OPENINGS

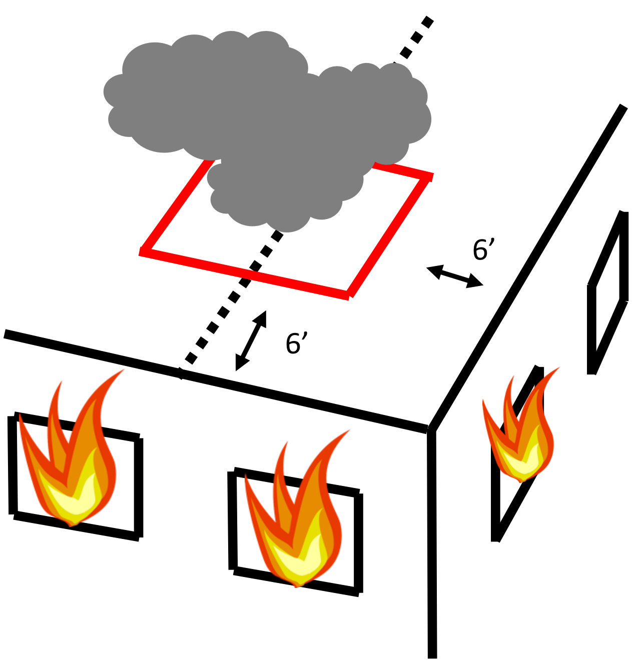
HVAC roof vents are frequently found on many different commercial buildings, in addition to roof access hatches, sky lights, and other roof openings. These roof vents can usually be quickly removed with a hand tool to provide immediate ventilation to the structure.

PARAPET HEIGHTS

When attempting to access a roof, understand that parapet wall heights may vary from building to building. By looking for roof drainage holes, known as scupper holes, that are located even with the level of the roof, firefighters can assess how tall the parapet wall is. The photo on the left shows one of these scupper holes. The distance from the scupper hole to the top of the building shows the approximate height of the parapet. This will help firefighters decide if they need to use a roof ladder on the back side of the parapet to access the roof, or if they can just step off onto the structure. Typically, parapets will be lower in the rear of the structure and may be easier to navigate there.

LIGHT AND AIR SHAFTS

Found in older structures, light and air shafts are used to help cool buildings and provide light to internal apartments. This is important for firefighters to understand; sometimes fire showing from the roof may actually be venting from a lower-level apartment window inside the shaft.



SIX FEET AWAY

When ventilating a residential flat roof, it is a good practice to always ventilate at least six feet away from the edge of the roof for several reasons. In smoky or dark environments, it may be easiest for firefighters to find their way around the roof by following the raised edges/parapet walls. Cutting six feet away from the edge provides a safe walkway around the hole. Also, in larger multifamily buildings, firefighters typically cut an 8′x 8′ hole. If the cut is started six feet from the edge of the roof and the hole is 8′ long, there is a good chance the cut will reach over more than one apartment. Very few rooms will be over 14′ long (6+8); this provides a better chance of ventilating the affected area.

RESIDENTIAL VERTICAL VENTILATION

OVERVIEW

- There are numerous effective ways to complete a ventilation hole on a residential structure. This section outlines the common louver/slit method from a roof ladder and aerial ladders
- The process outlined below for cutting from an aerial ladder does not change when cutting from a tower ladder

CREW

- For both roof ladders and aerial ladders, a two-person crew method will be demonstrated because it is the most common and the safest
- There is a good chance there might be more than two firefighters on the roof based on the severity of the situation, staffing available, specific directions, etc.
- Regardless how many people are assigned, the process to vent a hole does not change
- The two members will be identified as the Saw Firefighter and the Tool/Backup Firefighter

EQUIPMENT

- The two-person crew should take a minimum of a chainsaw, a hand tool (Used in case of saw failure or conditions that are too smoky for a saw to run), and a hook
- Tools to consider include the following:
    - Chainsaw
    - Flathead axe and Halligan
    - New York roof hook, D handle hook
    - Chainsaw
- Every ladder should have a pike pole (8’ or 10’) and an axe mounted near the tip of the aerial ladders or in the bucket on platforms

RESIDENTIAL LOUVER—ROOF LADDER

The photo below shows a variety of tools that could be used on residential roofs. Take the time to assemble the correct equipment for the job. This example depicts a firefighter cutting from a roof ladder. The blue arrow in the photo (below right) indicates the wind direction; the cut is being made on the leeward side of the pitched roof. This makes the hole more effective, since wind currents are not trying to push air back into the structure. Also, the firefighter is positioned on the windward side of the cut. This position gives the firefighter better visibility once the hole begins to vent; the smoke will move away from him.

In this photo, the saw firefighter begins making the top cut. If the pitch of the roof is too steep or too slippery, the tool firefighter could place a roof hook or Halligan under the saw firefighter's lead foot to create a foothold as demonstrated in the Helpful Roof Tips section. Notice that the saw firefighter is working from the farthest point in, always returning to the safest, most stable point: the roof ladder.

When making the top cut, the saw firefighter makes sure to "roll" over the trusses below to keep from slicing through them and weakening the roof structure. Also, this provides the saw firefighter a mental note of where the trusses are located. This is extremely important for the next step: selecting where to louver the roof. It is very hard to cut the entire hole from one position. After making the top cut, the saw firefighter may need to reposition on the ladder (photo on the left) before making the next cut.

After repositioning, the saw firefighter will then make the first down cut. This cut will be located inside the trusses. Notice how the saw firefighter overlaps the cuts; this is critical to make sure the material is fully cut and not still connected. This is a good practice to get used to doing; it helps the saw firefighter make sure the cut was made correctly even when visibility is limited.

Moving back toward the roof ladder, the saw firefighter will continue to make the down cuts. The cut the firefighter is currently making in the photo on the left is on the opposite side of the truss from the first cut. This will allow the truss to act like a fulcrum with the piece of roof above.

The saw firefighter continues to move back toward the safety of the roof ladder and makes an additional down cut. Notice how at this point the firefighter is safely on the roof ladder and is using the reach of the saw to make the last few cuts.

The saw firefighter finishes the last down cut in the photo on the left. Look at the top cut and notice how every down cut the firefighter has made has been overlapped with the top cut to ensure the material was cut completely through.

This photo shows that the roofing material underneath is constructed of 1 by boards. Due to this, the roofing material will just fall through when cut on both sides in between a truss span. This may be beneficial in certain scenarios; letting the roofing material fall may be the quickest way to ventilate. However, louvering the material on a truss can keep it from falling on interior crews below. Neither method is right or wrong; they are just different ways to complete the same task. Firefighters should understand the pros and cons of each method.

Once all the down cuts have been made, the saw firefighter will make a bottom cut that overlaps with all the down cuts previously made. Notice the saw firefighter is again working back toward the roof ladder. Again, this would be a time that a foothold may be useful.

Since the firefighters are operating off of a roof ladder, the tool firefighter just hands the saw firefighter the pike pole. This photo shows the firefighter pivoting the cut sections by striking the roof material with the D handle of the hook.

The photo on the left shows the firefighter using the other end of the pike pole to pull up on the cut material. Typically, a combination of striking down and pulling up will be used to finish the louver cut. The photo below shows a completed louver cut.

Once the cut is completed, it is imperative that the crews reach down with the pike pole and break out any intact ceiling that remains. Doing so gives the smoke and heat from the fire below a more direct exit path out of the structure. When performed correctly and in coordination with fire attack, vertical ventilation can dramatically improve conditions for interior crews while also increasing victim survivability.

RESIDENTIAL LOUVER—AERIAL LADDER

Before beginning, take the time to assemble the correct equipment for the job. This example shows a firefighter cutting from an aerial ladder; the steps below are the same when cutting from a platform. The blue arrow indicates wind direction; the cut is being made on the leeward side of the pitched roof. This makes the hole more effective, since wind currents are not pushing air back into the structure. Also, the firefighter will work the cuts back into the wind toward the windward side of the hole. This gives the firefighter better visibility once the hole begins to vent; the smoke will move away from him.

The saw firefighter starts by making the top cut and locating the trusses. The location of the trusses is key when selecting where to make the down cuts. “Roll over” the trusses with the saw to keep from cutting through and weakening the roof. After the top cut is complete, the saw firefighter makes the first down cut inside the last truss location. In this scenario, the firefighter should have increased visibility by working right to left. Doing so will cause the smoke to move away from him while not obscuring the remaining working area for the next cuts.

The photo on the left shows the firefighter moving to the left and making the next down cut on the other side of the truss that was previously located. Notice how the firefighter works back toward the safety of the aerial ladder, and all the cuts are overlapped to ensure each cut goes completely through the roofing material.

Repeating the same process, the saw firefighter moves to the left of the next truss previously located when the top cut was made. The saw firefighter then overlaps the cut and completes the third down cut.

The cut firefighter locates the last truss and completes the final down cut. Notice in the last two photos how the saw firefighter has changed their body positioning to be better orientated to the cuts being made. The initial top cut and first two down cuts were made with the saw in the right hand and the left foot in front, creating a solid cutting stance. The saw firefighter then switches their hands and foot positioning to maintain a solid cutting stance, instead of reaching awkwardly across their body.

The final cut is the bottom cut. Notice how the saw firefighter cuts above the end of all the down cuts to ensure all the cuts overlap. Also, the saw firefighter continues to work back toward the safety of the aerial device and now has both feet on the ladder.

The photo on the left shows all the cuts after they are completed. Notice how all the cuts overlap to ensure the material is cut completely through. The next step is to pivot the cuts with a pike pole.

At this point, the tool firefighter will pass the pike pole up to the saw firefighter. Due to the wind direction noted previously, the saw firefighter works right to left and begins to pivot the cuts on the trusses. By working right to left, the smoke from the louvers that are open will travel away from the firefighter, providing better visibility.

The photo on the left shows a completed louver cut. Notice how all the roofing material is still attached to the trusses and has not fallen below. The pros and cons of this were briefly discussed in the roof ladder ventilation section previously. At this point, the saw firefighter will reach down with the pike pole to clear any remaining ceiling material; this allows the products of combustion to travel up and out.

COMMERCIAL FLAT ROOF VENTILATION

OVERVIEW

- This section outlines one common method of ventilating a commercial roof. It is extremely important to acknowledge that there are countless different roof types and different methods for cutting each. To include all these methods in one manual would be next to impossible. Firefighters should reach out to their officers and senior firefighters, who can further expand on roof operations
- Regardless of the roof, the basic principles for commercial ventilation remain the same:
    - First remove the weather proofing and insulation materials to expose the roof decking underneath, then make the cuts

CREW

- Commercial roof operations are one of the most labor intensive and physically taxing job assignments on the fire ground
- Initially, one crew of four firefighters may be assigned to ventilate the roof. If at all possible, the IC should quickly reinforce this crew with additional staffing and equipment

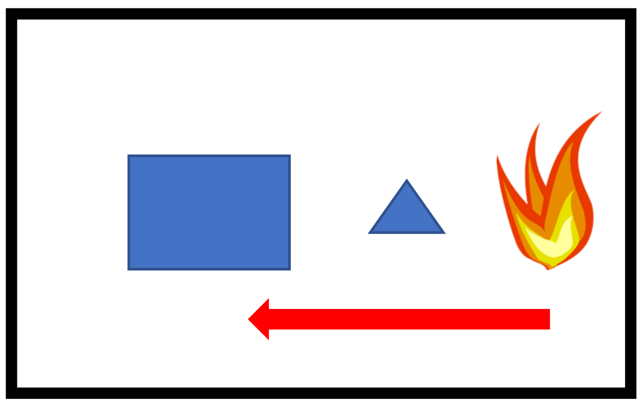
EQUIPMENT

- The initial crew should take a minimum of two chainsaws, two circular saws, and a hook
- Tools to consider include the following:
    - Two circular saws (DAX blade or Diamond blade)
    - Two chainsaws
    - Flathead axe and Halligan (Useful for HVAC vents, scuttle holes, skylights, etc.)
    - Trash hooks, New York roof hook, D handle hook
    - Utility knives and shovels

STEP ONE: INSPECTION HOLE

- After accessing the roof, firefighters must decide where to open the roof
- Unlike a residential structure where firefighters would typically try to vent directly above the fire, on a commercial roof firefighters need to think farther ahead
- While firefighters still want to ventilate in the area of the fire, it is critical to remember that the area directly above the fire will be weaker after being exposed to heat
- Firefighters must anticipate the direction the fire is traveling and select a cut location ahead of the moving fire
- The inspection hole should be located between the fire and the selected location where the roof will be ventilated
- <u>The inspection hole serves 3 main purposes:</u>
    1. Determine which direction the roof decking is traveling; this will typically tell firefighters the direction of the truss system below the decking
    2. Check the current fire and smoke conditions under the roof that crews are on
    3. Gives advanced warning to crews who are cutting the main ventilation opening. For example, if firefighters look over and see there is now fire coming from the inspection hole that previously only had smoke coming from it, they know that they have limited time before the fire reaches them

The diagram on the right depicts the location of the inspection hole in comparison to the location of the fire and the desired vent hole. The example shows that the fire on the right side of the building is traveling to the left. The inspection hole (triangle) has been placed between the main ventilation hole (rectangle) and the fire.



The photo on the left depicts a variety of tools that could be used on a commercial roof. Take the time to assemble the correct equipment for the job; this will be a very resource heavy operation. Carry as much equipment as possible to the roof to minimize trips. Firefighters will likely use all of their truck's saws. It would be a good idea to include a utility rope bag with the initial equipment cache; it could be used to hoist additional tools up later.

As soon as crews make access to the roof, two things must occur. First, crews must check the stability of the roof and continue to check it while moving to the desired location. Second, crews must ensure there are two points of egress off the roof, preferably opposite each other. This could consist of ground ladders, aerial ladders, gooseneck ladders, or even another attached roof. The concept is simple; there must be a secondary way off the roof in case things go bad. Notice in the photo on the right the officer has the circular saw slung with a piece of webbing. This is a great way to maximize the amount of equipment that can be taken to the roof, while still allowing the officer to maintain three points of contact when climbing the aerial ladder.

Once the situation has been reconned and the decision has been made to vent the roof, the next step is to make the inspection hole. The saw firefighter begins by making a full depth cut with the circular saw. Notice how the officer's hand is floating just above the saw firefighter's back. The officer is acting as a safety whenever the crew is cutting. The officer will tap or grab the saw firefighter if they want them to stop cutting.

The saw firefighter will continue to make three overlapping cuts forming a triangular shape. It is extremely important to remember two things while making these cuts. First, all the cuts must overlap to ensure they are cut all the way through. Second, the triangle must be big enough to allow the circular saw blade to drop down into it and reach the roof decking material below.

Once the three triangular cuts have been completed, the tool firefighter can begin removing the weather proofing and insulation to expose the metal decking below.

This roof was made of multiple layers of material. The photo on the right shows multiple firefighters working together to remove the material from on top of the metal decking.

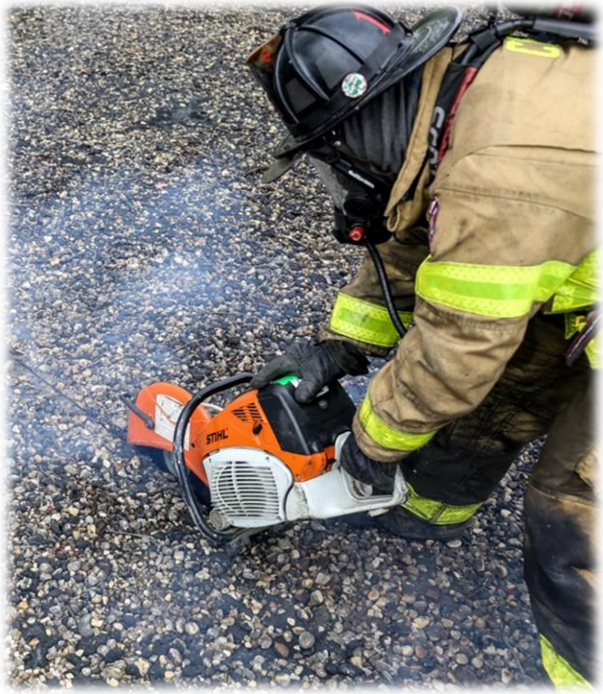
Once the material is removed, the metal decking below can be seen. At this time, it is important that firefighters take note of the direction the decking is traveling; this information will be needed when firefighters cut the actual ventilation hole. For the most part, the truss system below will run the opposite direction of the metal decking.

After exposing the decking, plunge the circular saw blade into the opening created and begin making three more overlapping triangular cuts. Again, notice that the original cuts had to be large enough to allow the circular saw head to drop down and reach the metal decking.

Finish the remaining cuts of the triangle. Remember to overlap the cuts to ensure that the cut is made all the way through.

Once the metal decking material is opened up, crews can then use the inspection hole to assess the conditions below. The hole can also act as a warning system for crews while they cut the main ventilation hole. If only smoke was coming from the inspection hole initially but later in the incident fire is venting from the hole, firefighters will know the fire is moving toward them as they cut the main ventilation hole.

STEP 2: MAIN VENTILATION HOLE



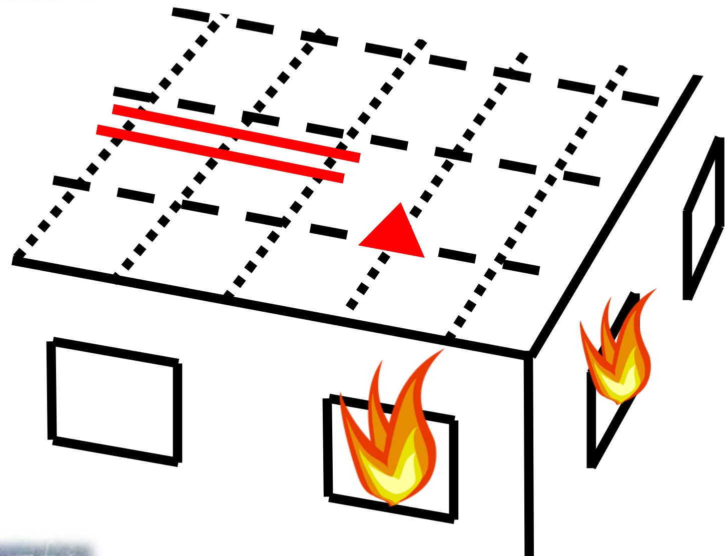
After the inspection hole has been completed, firefighters can begin working on the main hole. Because of the inspection hole, firefighters should now know what direction the metal deck roofing material runs. Firefighters will start by making two side-by-side cuts that go the length of the hole they want to make. These cuts should run parallel with the decking material. Essentially, firefighters are making a channel to access the metal roof decking below, making sure it is wide enough to fit the circular saw down into. Typically, firefighters should be looking for three trusses, since commercial trusses are commonly spaced 4’ on center. By finding three trusses, firefighters will essentially know the length is around 8’.

= First two cuts of main hole

= Inspection hole

= Direction of metal decking

= Direction of truss system



The photo on the left shows the saw firefighter making the second cut for the channel about a foot apart from the first cut. Notice how the firefighter has the full depth of the circular saw blade buried into the roof material to maximize the cut.

In this training scenario, once both cuts were made the tool firefighter used a shovel to attempt to clear the gravel in-between the two channel cuts. The gravel on this roof was essentially baked into the top layer of material and was very difficult to remove. Because of this, the tool firefighter's gloves are not on because the extra grip was needed to remove the gravel. Full PPE and SCBA should always be worn while ventilating a structure.

With as much of the gravel removed as possible, the chainsaw can then be used to cut sections into the channel made previously. This will make removing the insulation and weather proofing material easier by breaking it into more manageable sections.

The photo on the left shows the tool firefighter using the trash hook to punch into the insulation and begin removing it. The trash hook is extremely effective on commercial roofs; it works great to remove roof insulation material.

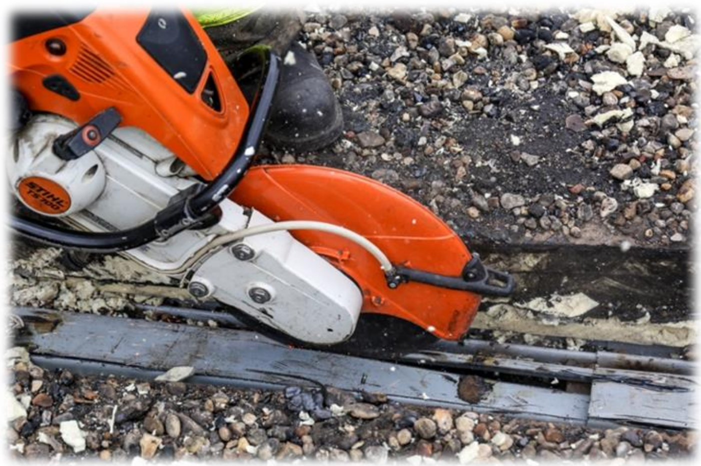
In the photo on the right, the channel cut by the roof team can be seen more clearly. Again, notice that the channel is wide enough for a circular saw to reach the decking material below.

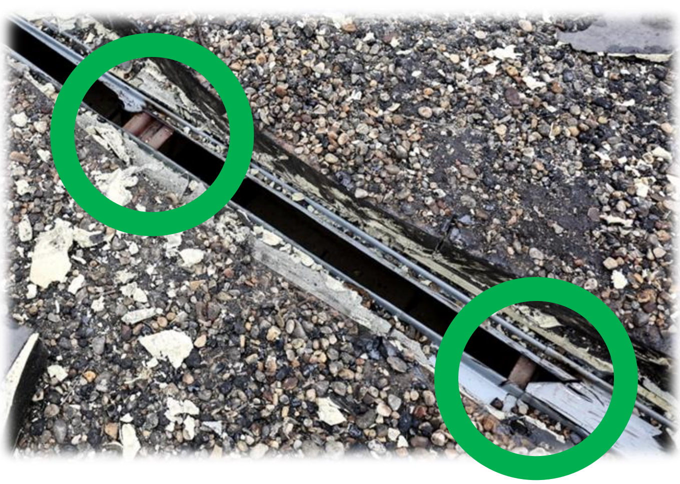
With the two channel cuts exposed, crews begin to remove the layers of roofing material. This is where the trash hook becomes extremely useful; the fork end of the tool is able to ride the channel of the decking material and pry up from below.

The photo to the right shows the exposed decking after the roofing material is removed. Now that the decking is exposed, the crews can begin to work on exposing the truss system below.

In the center of the photo on the left, a circular metal fastener can be seen. These fasteners are what fasten the actual decking material to the truss assembly below. These can help firefighters get a general idea where trusses may be located; however, firefighters still need to expose the trusses below. Not only are truss locations critical for the next step of the process, but the cuts used to find the trusses also act as one of the cuts for the ventilation hole.

The next step is for the saw firefighter to cut an additional channel out of the metal deck material. The photo on the right shows the firefighter beginning their first cut of the decking material. The cut is made parallel with the channel cut that was made previously.





This photo shows the complete channel cut of the metal deck material. The intent of making this cut a channel instead of a singular cut is to clearly identify the truss system below. If smoke conditions are present, a pike pole can be placed in the channel and slid left or right until it strikes the trusses. This is simply an idea for helping locate the trusses below if smoke conditions are present.

Now that the trusses have been located, the crew can remove all the roofing material over the entire area where the ventilation hole will be located.

The saw and tool firefighter work together to cut the material up into manageable sections and remove them.

This process is repeated over and over until the metal decking material below is exposed to the desired size of the ventilation opening.

Typically, using the chainsaw is the fastest way to “dice” the material up into the smaller sections. There is a strong possibility the chainsaw’s chains will dull quickly; roof crews will need to have the mindset that every saw will get used. Remember to ask for additional equipment early in the operation.

The photo to the right is a great example of how the trash hook is a fantastic tool to use on commercial roofs. Notice how the tool firefighter is able to punch and grab the material with the forks and pry backwards.

Once the decking material is exposed, the roof team can begin to make their cuts. The team locates the trusses from the channel that was previously exposed and begins to cut in line with the truss system (red lines). Notice that both firefighters are making their cuts while standing on the opposite side of the truss from where they are cutting. This keeps them on the safe side of the trusses. The officer continues to act as a safety for the crews.

After the first two cuts are made, the saw firefighter moves to complete the last cut on the edge of the hole. Again, the saw firefighter is working from the safe side of the truss system. Since the bottom cut has not yet been completed, the first section of decking that was cut is still attached and is just sagging into the building.

With the last cut (far left in this photo) made, the tool firefighter or the officer can use a pike pole to strike the decking material off the center truss. At this point, the decision can be made whether or not to complete the bottom cut. Similar to louver cuts made on residential structures, either way is acceptable; it simply depends on the scenario. If crews are operating below the hole, it may be best to leave the decking material attached to keep it from falling on them.

If there are no crews below and firefighters want to maximize the effectiveness of the vent hole, the bottom cut can be completed to create the largest opening possible. The photo on the right shows the completed ventilation hole. In this scenario, the bottom cut was made and the decking material dropped below to maximize the vent hole.

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WATERWAY OPERATIONS OVERVIEW

TRUCK OPERATIONS MANUAL

SECTION TOPICS

Waterway Operations Overview

Offensive Operations

Defensive Operations

Flowing Water from a Tiller

Flowing Water from a Platform

Other Considerations

SECTION OBJECTIVES

Understand how to position the aerial or platform for offensive operations

Understand how to use a flying/elevated standpipe

Understand how to flow water from a tiller

Understand how to flow water from a platform

Understand how cold weather affects waterway operations

WATERWAY OPERATIONS OVERVIEW

OVERVIEW

This section will discuss how to put master streams in service through an aerial or platform apparatus. Firefighters need to consider many factors before they can get an effective fire stream in place via an elevated master stream device. Those factors will be addressed in this section.

CONTENTS

- Waterway Operations
- Offensive Operations
- Defensive Operations
- Flowing Water from a Tiller
- Flowing Water from a Platform
- Other Considerations

WATERWAY OPERATIONS

OVERVIEW

There are a few decisions the driver must make when asked to set up the truck to use the waterway. The first decision on any incident is almost always about the positioning of the apparatus. This can sometimes be a difficult task to accomplish due to obstructions or lack of access. When initially arriving on scene, the ladder driver may not know if they will be using their aerial for offensive or defensive operations. Other times, the Incident Commander may have a predetermined location they will direct the ladder company to upon arrival. A fire that seems it is going to be contained quickly may expand beyond a quick knockdown and suddenly require the aerial to be used for elevated master stream application.

Once positioning is accomplished, the driver will progress to setting up the truck and getting water to the ladder's intake valves. Many times, the driver will have assistance from at least one engine company; the driver may also have their other ladder crew members assist them with water supply if they are available. The extra hands may give the driver time to set up the truck while someone else is working on getting water to the ladder. Larger operations may require long water relays be performed to establish water; understandably these long water relays will take time.

The following pages will briefly cover offensive and defensive ladder operations, then progress into flowing water from Aerial/Tiller and Platform ladders. These are general overviews; they are not a comprehensive guide to flowing water. Proficiency in these operations requires crews to periodically discuss and practice them.

OFFENSIVE OPERATIONS

OVERVIEW

Most of the time when water is being flowed from a ladder's waterway, it is thought of as being only for defensive operations. There are some fires where the ladder can be used to deliver large amounts of water quickly to overwhelm a large volume of fire, or a fire not easily accessed by handlines. In these situations, the ladder driver's goal is to get the truck set up and have water flowing out of the nozzles as quickly as possible; the goal is to get a good knockdown on the fire to prevent a defensive operation. Water supply to the truck will have to be established more quickly in these situations than at defensive fires, because the goal is to extinguish the fire quickly before it consumes the building. The ladder company will need to be paired with an engine company, and communication between the ladder driver and the engine operator will be crucial. Using the ladder this way can be thought of as transitional attack, but the operation can quickly become defensive if crews do not work together efficiently. With the fire knocked down, engine companies may be able to proceed to interior attack or overhaul operations.

If directed to use the ladder in an offensive attack, the ladder driver must understand where to position the bucket or tip of the ladder. Know where the target is, if the fire can be reached with the ladder's water streams, and if it is safe to put firefighters on the end of a ladder in that area. As mentioned previously, water supply will be critical for this type of operation, and the driver will need to be close enough to their truck to feed the ladder quickly. An offensive attack will often be performed by placing the bucket or tip at a low angle and pointing the nozzles toward the ceiling of the involved structure. This strategy works well to put large volumes of water through store front windows at taxpayer style buildings or through overhead door openings at commercial warehouse buildings.

Another way the aerial or platform can be used offensively is as a flying/elevated standpipe. If a standpipe system is not available within the building, using the ladder pipe as a standpipe is an option. This is generally performed by using an exterior opening, such as a window, that allows the fire attack team to connect their high-rise pack or acme pack to the ladder pipe. Parking garages and fires on top of a commercial roof are some examples where using the ladder as a standpipe could be considered. On residential roofs with a fire running the attic, firefighters can use a short section of hose to connect the piercing nozzle or Bresnan distributor to the end of the aerial or platform to flow water into the attic from above the roof instead of below. One of the major draw backs to using a ladder as a flying standpipe is that the truck is now locked into that task and can no longer be used for victim rescue. These processes will take practice, and the crews involved must be well coordinated.

[Click here to view Target Solutions video on Piercing Nozzles]

DEFENSIVE OPERATIONS

OVERVIEW

A defensive fire is one where the involved structure is being written off due to the amount of fire upon arrival. Priorities will switch to protecting exposures, while still attempting to extinguish the primary fire. If the operation is known to be defensive, good truck positioning will focus on making sure the elevated master streams will be in a usable position. Stream location above the fire area is important for making a defensive attack. Once ordered to set the truck up for a defensive strategy, ladder drivers should take note of a good location to spot the truck. **Be sure to consider the collapse zone of the building.** If firefighters are already writing off saving the building due to the initial fire load and extent of fire involvement, the chances for collapse should be considered above average. If possible, taking a position on the corners of the building is usually ideal; this can give the ladder access to multiple sides of the building while still having the apparatus in a safe position. Understandably, this may not always be an option at large commercial buildings with a fire in the center of the building.

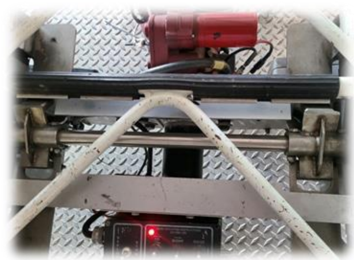
Unlike focusing on fast supply when doing offensive operations, the focus for defensive operations is more on ensuring there is enough water supply. Since it has two nozzles, the platform has the ability to flow more water than a tiller and may be more ideal for defensive operations. However, that is only true if enough water is available. For defensive operations, the more water the better. At this point, firefighters are no longer concerned about floors collapsing under water weight. The priority now is to slow or stop the fire spread before it endangers more people or property. Crews will need to recognize whether or not they are on a good water supply that is able to provide large amounts of water. If the needs of the incident exceed the initial water supply available, Incident Command will need to direct companies to establish supply from another source. Always assess the situation and have a plan before putting the ladder into the air.

FLOWING WATER FROM A TILLER

SWITCHING FROM RESCUE OPERATIONS TO WATERWAY OPERATIONS

Once the truck has been positioned where it can be used, crews will need to ensure the nozzle is "pinned" for waterway operations. All the CFD aerial ladders have pinnable waterways. Pinning the waterway for waterway operations causes the nozzle to be locked onto the fly section; this means the nozzle will stay with the tip of the aerial ladder. Pinning the waterway for rescue operations means the nozzle will stay with the inner fly section, which keeps the nozzle out of the way when it is not being used. The ALF/LTI tillers will either have a removable pin or a flip lever to change from rescue operations to waterway operations. Aerials should be pinned in rescue operations unless it is known that they are going to be flowing water.

This process is often referred to as "pinning the ladder." The photos on the left show the movable pins style, while the photos on the right show the flip lever style.



QUICK-LOCK

On Pierce ladders, the operation is slightly different than the ALF/LTI ladders. A device called the Quick-Lock is used to select which section the nozzle stays with. The Quick-Lock essentially performs the same operation as the pin on the LTI. It is operated by a small handle on the side of the last section of the ladder. With the handle placed in the forward position, the nozzle will be held with the fly section of the aerial. This is the position that should be used for flowing water from the aerial. If the quick-lock handle is placed in the rear position, the nozzle section will stay with the inner fly section of the ladder, otherwise known as rescue mode. Remember that the arm inside the ladder has to physically move; firefighters must ensure it engages properly to change the nozzle position. This process can be slightly confusing if not done frequently; firefighters should familiarize themselves with operating the Quick-Lock if on a Pierce Aerial for the shift.

SAFETY CONSIDERATIONS

Regardless what ladder truck firefighters are on for their shift, it is very important that they set the position they want the nozzle in before pressurizing the waterway. If these are not set before putting water in the waterway, it could cause serious injury to the operator and severely damage the aerial device. If a position is not locked in, a pressurized aerial waterway can move suddenly and violently, causing injury to those within its vicinity. When arriving on scene for a scenario where the aerial will be flowing water, it is usually easiest if the Tiller firefighter does the changeover before moving to the ground.

A situation may arise where the ladder had already been in operation in rescue mode, and the incident now requires the aerial to be used to flow water. In these scenarios, the operator must make sure the ladder is **<u>fully retracted</u>** before changing the nozzle position, but the ladder does **<u>not</u>** need to be bedded.

AERIAL NOZZLES

The ladder is going to be used for water delivery in one mode or another. How much water is needed, and how much pressure is required to get a good stream? Just like with handlines, the flow and pressure are determined by the nozzle that is being used. Throughout the Division, the aerials run with three different types of nozzles illustrated below.

STACKED TIPS

A set of stacked tips is one of the options on the aerial. This set has a stream straightener at the base, followed by a group of tips starting at 1 3/8" and going to a 2" tip as the largest size. Depending on how much water is needed for the application the nozzle is being used for, the tips can be removed. Some tips will need to be removed to perform the flying standpipe operation. A gated wye or gate valve can be implemented for those types of operations.

AKROMATIC 1250

The Akron automatic 1250 is a combination nozzle that can be found on some of the ladder pipes around the city. This nozzle gives firefighters a choice of a straight stream or a wide fog pattern. The operator has a choice on what stream they want to use, and they can control it electronically from the pedestal or from the tip.

SABER MASTER

The Saber Master is the third option available for ladder pipe nozzles. Like the Akron automatic 1250, the Saber Master is a combination nozzle. However, the Saber Master can change from a wide fog to a solid stream. This solid stream will act like the 2” tip from the stacked tips mentioned earlier. With the proper supply, a 2” solid stream from this nozzle will provide a maximum flow of 1,250 gallons per minute.

SUPPLYING THE AERIAL

CFD tractor drawn aerials do not carry tank water on them, nor do they have their own pump. To use the waterway, the ladder truck will need to be supplied by an engine company. The ladder operator will need to work hand in hand with the engine pump operator. The engine operator should ensure they are on an adequate water supply. This supply could be from a good hydrant or from another engine company. The aerial device is going to use a significant amount of water. If the engine operator is already flowing water (residual pressure) with the intake gauge near zero, this indicates that there is little water left, and it will not be able to sustain an aerial master stream. Alternatively, if they are not flowing any other water prior to charging the aerial (static pressure), then they will not know if the current supply will support the aerial waterway until the aerial is flowing.

If there is insufficient water supply, crews will need to work on establishing water from another source. There are various scenarios that can arise on scene; however, communication between companies on scene will generally make or break how quickly a sufficient supply is established. Remember that there is little point in focusing on getting lines between the aerial and engine if the current supply cannot sustain the operation. Once the engine operator ensures that they have a solid water supply, they can begin to lay out hose to charge the aerial waterway.

TILLER CONNECTIONS

There are several different ways supply hose can be laid out to supply water to aerial ladders. One of the more common ways is to establish dual 3” supply lines to the turntable. Newer Pierce tillers also have the option of using either 3” or 5” Storz connections, depending on the operator’s desire. A 3” line can be established quickly to start flowing the aerial waterway, but it will only support around 800 gpm max. A second 3” line will need to be placed to maximize the flow, depending on the tip being used.

The ladder operator should ensure the nozzle is “pinned” in waterway operations and make sure the nozzle is pointed at the intended target. As mentioned previously, starting with one 3” supply line between the engine and the ladder will support an effective stream initially. Once the supply hose is connected to the ladder turn table and is ready for water, the ladder driver can signal to the engine operator that they are ready.

Ladder 8 was able to provide an effective defensive stream with an initial 3” supply

AERIAL INTAKE VALVES

It is recommended that tillers run with their intake valves closed to prevent the possibility of a supply line being prematurely charged and allowing water to enter the waterway, exit the nozzle, and discharge into an unintended location. This could be extremely dangerous to the equipment and crew members on scene. It is recommended that the aerial be positioned with the nozzle aiming toward its intended target prior to calling for water in the lines. If the aerial and nozzle are out of position, the aerial operator should only call for water if they are **<u>absolutely</u>** sure the intake valves are closed. It may be a good idea to remove the intake cap on the side opposite the initial intake if starting with only one supply line. If water leaks past the intake valve or the other valve is open, the cap on the intake not being used could become pressurized (Similar to an FDC cap that is not removed when a FDC is supplied with water). This would create a hazard for any firefighter attempting to remove the cap to add a second supply line.

<u>Note</u>: Newer Pierce tillers have external indicators on the valve body showing whether the valve is open or closed. However, some older LTI ladders have intake valves that give no indication whether the valve is open or closed. Also, keep in mind that not all intake valves are the same. Some intake valves require the handwheel be turned counterclockwise to open (as expected), but some intake valves will need to be turned clockwise to open.

CHARGING THE LINE

The engine operator should have the line hooked into a discharge off of their pump. The line should be charged slowly, **only when the aerial operator calls for water**. Remember that this is a supply line, not a handline. Hose lines carrying large water must be charged slowly, or they could move violently and hurt someone. The 3" Storz is non-locking and has a tendency to spin free of its connections if not laid out in a straight line. Once the line is full of water, it should be pressurized to around 150 psi at the turntable. Start the pressure at 150 psi and adjust from there. At this point, check to make sure the stream from the ladder pipe is functional. There are many factors that go into moving big water. When flowing water from an aerial, maintaining a functional stream is the most important part of supplying the waterway.

CHARGING THE SECOND LINE

At this point, lay out the second 3" supply line; both operators should be sure to communicate with each other. The engine operator will need to check their residual intake pressure to ensure that they will be able to support the second line. Since the engine is already running at more than 150 psi discharge pressure, charge the second line slowly. It is not desirable to throttle down after charging the initial line. For this reason, the valve on the pump panel must be opened slowly when charging the second line. The dual supply lines sharing the water delivery to the ladder should make it easier on the engine to supply the ladder, even if the extra water is not needed. Once the second 3" line is charged, be sure to evaluate the stream again. If the stream appears weak or over-pressurized, the engine operator may have to adjust their discharge pressure accordingly. Remember, it is not the engine operator's responsibility to make sure the ladder has a functional stream. It is the ladder operator's job to make sure the equipment they are responsible for is doing its job as needed.

This process is **not** the only way an aerial can be supplied, but it is the most common way within the Division. Firefighters should familiarize themselves with the process their company uses to supply a ladder. Also, be open minded when another firefighter shows a different way that their company might set up an aerial ladder for using the waterway.

NOZZLE CONTROLS

The movement of the aerial nozzle can be controlled via the pedestal controls, the tip controls, or the remote control. These options allow a firefighter to be positioned at the tip of the aerial, where they may have a better vantage point from which to direct the stream of water. If there is any concern about being able to safely place a firefighter at the tip of the aerial or if the aerial operator is running the stream by themselves, the nozzle can be operated from the pedestal. In addition, all CFD ladder trucks have a way to manually move the nozzle in case there is an electrical failure of the nozzle controls. Manually moving the nozzle is usually performed via some sort of wrench or knob.

AERIAL TIP CONTROLS

CFD Tillers are also equipped with aerial tip controls to allow a firefighter operating there to make positional changes. The way these controls are activated can vary from generation to generation and from one ladder manufacturer to another. The photos to the right show the process for giving the firefighter power at the tip controls. This operation requires two firefighters, with one at the pedestal. The firefighter at the pedestal holds down on the Remote Aerial Control Activation Switch and depresses the dead man's foot pedal switch. The firefighter at the tip should then see their indicator light come on; this tells them they now have power to the remote tip controls. The remote tip controls will function in a creep mode, moving the aerial slower than the pedestal controls. This is just one variation of how these controls are activated; operators should be sure to familiarize themselves with their ladder's controls.

FLOWING WATER FROM A PLATFORM

SETTING UP THE LADDER FOR WATER AND POSITIONING THE BUCKET

This section will discuss the process for setting up the platform to flow water. Positioning will be dictated by the initial task the ladder company is attempting to accomplish (rescue, ventilation, master streams, etc.). Crews will need to choose an appropriate position for setting up the ladder in preparation for flowing water. The ladder operator will set the truck up and prepare for the bucket firefighters to raise the bucket into position. Firefighters in the bucket should make sure they have the appropriate PPE for the task they are being asked to do. Which firefighters climb into the bucket may be different for each crew based on each situation, but the officer will generally be one of the two firefighters in the bucket. As firefighters begin to raise the ladder out of the bed, they should make sure they have full control of the platform from the upper controls. Constantly check the surroundings for power lines or other obstructions. The ladder operator on the ground should try to be cognizant of where the bucket is while it is being raised. From the ground, the ladder operator is another set of eyes that might be able to see more than what the firefighters in the bucket can see. The pedestal controls are able to override the bucket controls if the firefighter on the ground sees a hazard the bucket firefighters are unaware of. Once the firefighters have reached the position where they want the bucket to be, they can set up and position the nozzles. Adjust the nozzles so they are pointed at the target.

SUPPLYING THE PLATFORM

The platform operator will need to establish a water supply to the platform. The major difference between the platform and the aerial is the platform has a pump. The platform ladder does not necessarily need an engine company to supply it with water. The platform can connect directly onto the hydrant and use its pump to supply the waterway. However, many times the platform ladder company does not carry a large amount of hose, if any (some companies carry around 100' of 5" or a short 25' section). Having a hydrant nearby to connect to is not always an option. If the platform crew is planning to connect directly to a hydrant for supply, do not sacrifice good positioning to spot a hydrant. The platform operator will usually be working in tandem with an engine operator to secure a water supply using 5" supply line. Once a 5" hose is connected between the two trucks, the platform operator can call for the engine operator to charge the 5" hose.

INTAKE VALVES

CFD platform ladders have a few extra valve controls for flowing water from the ladder pipes compared to the tiller ladders. Newer platforms have 5” intake valves similar to those found on engine companies with Waterous pumps. Older trucks may have external valves found with Hale pumps.

Waterous Pump

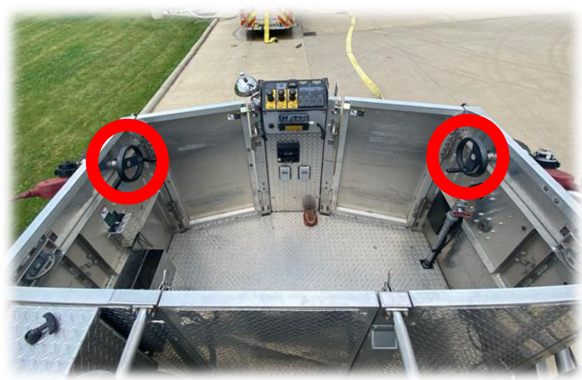
Hale Pump

WATERWAY CONTROL VALVES

The waterway control valves allow water from the pump to enter into the waterway. There is one electronic waterway control valve located at the pump panel on the driver’s side of the platform. Pushing and holding the electronic controls will open and close the waterway. If the electronic valve is not working, use the manual valve on the pump panel on the officer’s side of the truck.

NOZZLE HANDWHEEL CONTROLS

Inside the bucket there are also manual handwheels to control the flow of water from the waterway to the aerial nozzles. There will be one on each side of the bucket to control each nozzle individually. Newer platforms are replacing one of these handwheels with an electronic valve. Each company will decide how they wish to run the various valve controls on the platform. Some companies may leave the waterway open and the nozzles closed, or vice-versa. The driver must be aware whether the waterway and nozzles are open or closed to prevent accidental discharge of a master stream. It is recommended that the platform intake valves be left closed to ensure the platform operator has control of the water entering the pump, in case the 5” supply is accidentally charged before the ladder operator is ready for it.



The photo to the left shows an example of what electronic nozzle controls look like.

PLACING THE PLATFORM INTO PUMP GEAR

Before bringing water into the pump, check to ensure the 5" intake valve is closed. Next, the ladder driver can signal to the engine operator to charge the 5" hose. Having the intake valve closed initially gives the ladder driver the most control over the water as it is introduced to the truck. Once the 5" supply hose is charged up to the main intake, start to slowly open the intake valve. Water should now be in the platform pump (check the intake gauge to confirm this).

At this point it is safe to put the pump into pump gear. In the cab, the process for putting the truck into pump gear is the same as on an engine. Before leaving the cab, be sure there are two green lights on the pneumatic shifter and 10-15 mph showing on the speedometer. The pump should not be engaged unless there is water coming into it. Running the pump dry can cause serious damage to the pump. Once water is coming into the truck and the truck is in pump gear, take note of the intake and discharge pressures on the panel. Knowing the initial pressure can be very useful, especially if extremely large amounts of water are going to be used. Residual pressures will not be discussed in detail in this section. However, remember that when the intake gauge reads zero, there is no more water left to use.

Note: Something to consider about when to place the platform into pump gear is the high-idle function. The operator may wish to wait until the bucket has reached its desired position, rather than placing the truck in pump gear as soon as water has entered the pump. Once the platform is placed into pump gear, the ladder will lose its high idle function; this could slow positioning of the bucket. Deciding when to place the truck into pump gear is up to each crew and the situation at hand.

CHARGING THE WATERWAY

Begin to open the main waterway valve. The waterway electronic control valve can be found on the left side of the pump panel underneath the master intake and discharge gauges. This will charge the waterway and begin to pressurize the nozzles. As mentioned previously, the bucket operator may choose to do this with the controls located within the bucket. If the electronic waterway controls fail, there is a manual override wheel located on the officer's side pump panel.

Watch the display to make sure the waterway is completely opened or closed

OPENING THE NOZZLES

Once there is water in the waterway, the nozzle handwheel valves can be opened to begin flowing water from the nozzles. Again, ensure the nozzles are aimed at the intended target prior to flowing. Once the nozzles are flowing, the platform operator can adjust the discharge pressure by using the throttle controls on the pump panel. The platform operator can also begin checking how effective the water supply is. The goal is to always maintain an effective fire stream. Some water supplies may not be able to support having both nozzles fully open. If no additional water can be supplied to the platform and the intake is reading zero, it is generally best to shut down one of the streams to maintain at least one effective stream, rather than two weak streams.

NOZZLE SELECTION

The two nozzles on the bucket can be any combination of the aerial nozzles mentioned previously. The most common nozzle complement is shown in the photo on the right: a Saber Master nozzle on the driver's side, and a stacked tips smooth bore nozzle with a stream straightener on the officer's side. The driver's side nozzle will also have electronic controls that can be operated from within the bucket.

OPERATING THE PLATFORM PUMP

CFD platforms have various pump controls depending on the generation of the truck—manual throttle, Hale Captain Pressure Governor, and Pump Boss. Platform operators should familiarize themselves with these controls whether they are on their normal ladder, in a backup truck for the shift, or TT'd to a ladder they do not normally drive. The Hale pressure governor will operate similar to the Pump Boss pressure governors, but it will not automatically go into PSI mode when the pump is placed in gear. The operator needs to press the green MODE button to set it to Pressure mode (PSI on the Pump Boss) or to change it to RPM mode. If the platform operator can achieve a discharge pressure around 150 psi, that is usually a good starting point. Evaluate the quality of the streams and increase pressure from there to achieve the desired flow.

Hale Captain Pressure Governor

ADDING AN ADDITIONAL SUPPLY LINE

CFD platform pumps are rated to 1,500 gpm just like CFD engines. However, it is possible to flow closer to 2,000 gpm with a positive source (hydrant pressure, supply from an engine company). Once the 5" supply is established, the supply engine can determine if it still has enough water available to provide an additional 3" line to increase supply to the platform. This should also allow the supply engine to run at a lower RPM than with just the single 5" supply. Like the aerials, this process for flowing water from the platform is not the only way for this operation to be performed. These operations should be practiced to ensure companies have the competency to perform effectively on the scene of an incident.

OTHER CONSIDERATIONS

COLD WEATHER OPERATIONS

When operating elevated master streams at a scene during freezing temperatures, consideration should be given to keeping the waterway from freezing. Some scenes may require the aerial stream to flow intermittently and remain in the air in case more water is needed. When the metal waterway piping is exposed to sub-freezing temperatures, the water inside can rapidly freeze, turning it into a solid tube of ice. If the aerial needs to be left in the air, keeping a small amount of water flowing will prevent the water from freezing until the waterway can be drained and stowed. Extending and retracting the ladder should be performed periodically to prevent ice buildup.

PLACING A FIREFIGHTER AT THE TIP

The decision to place a firefighter at the tip of the ladder is dependent on the situation. There is no denying that placing a firefighter at the tip/bucket provides an elevated view of the overall scene, and they will be able to direct the streams more accurately. Consideration should be given for the safety of the firefighter at the tip. Sudden changes in wind direction or a building collapse can cause smoke and fire to quickly envelope the tip of a ladder as shown in the photo below. Firefighters should be wearing full PPE and SCBA. The bucket provides more protection for firefighters from sudden changes in heat and smoke direction, but the aerial can operate more remotely using the nozzle controls at the pedestal.

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SALVAGE AND OVERHAUL OVERVIEW

TRUCK OPERATIONS MANUAL

SECTION TOPICS

Salvage and Overhaul Overview

Salvage Operations

Salvage Tools

Salvage Functions

Starting the Overhaul Process

Common Void Spaces

SECTION OBJECTIVES

Understand when to start salvage operations

Understand how to use various tools for salvage

Understand how to perform salvage to minimize water damage

Understand how to perform salvage to minimize smoke damage

Understand how to use various tools for overhaul

Understand common void spaces and how they affect overhaul

Understand how to preserve evidence for arson investigators during overhaul

SALVAGE AND OVERHAUL

OVERVIEW

- Even after the fire is contained, the responsibilities of the on-scene ladder companies are only just getting started
- Life Safety will always be the primary goal on any incident, followed by Incident Stabilization and Property Conservation
- The most common examples of Property Conservation that firefighters will generally be performing is Salvage and Overhaul. Both these functions are critical ladder company functions that should not be overlooked or taken lightly
- Our oath to save property is not accomplished until these tasks are completed in their entirety

CONTENTS

- Salvage Overview
    - Salvage Operations
    - Salvage Tools
    - Salvage Functions
- Overhaul Overview
    - Starting the Overhaul Process
    - Common Void Spaces

SALVAGE OPERATIONS

OVERVIEW

Salvage involves saving property that is at risk of being completely destroyed. Smoke and water damage can often cause more damage than the actual fire. Removing or diverting these two threats can make all the difference in saving someone's property and minimizing damage. Firefighters can utilize salvage techniques not only on structure fires, but also on other service calls such as water leaks. Throughout their careers, firefighters should consider the following:

- If it was your house, how would you want your belongings to be treated?
- The occupant's home (structure) may be damaged beyond repair, but that does not mean they have to lose the rest of their personal items through careless actions
- Occupants may or may not have insurance to replace their home or large items in their home; however, some items simply cannot be replaced
- Many times, what is inside the occupancy is all a resident has; save what you can

WHEN TO START SALVAGE OPERATIONS

How and when salvage operations are implemented is very dependent on the situation; additional companies beyond the initial response may be required. Initial companies will generally be focused on accomplishing Life Safety and Incident Stabilization operations, and they will not be able to dedicate much time to salvage early on in the incident. Once the Life Safety and Incident Stabilization priorities are met, Salvage operations should be started immediately.

Firefighters should be **proactive** when it comes to salvage. A firefighter who is part of a ladder company should immediately be thinking about salvage when the time is appropriate. For the Tiller/OSV firefighter, this means bringing salvage tools/material up to the door as soon as possible. Generally, the Tiller/OSV firefighter would do this upon completion of the exterior tasks, and when the fire appears to be under control. The Inside firefighter can begin salvage after overhaul procedures have determined fire extension is non-existent.

This is not to say that Salvage can only be started once the fire is completely out; Salvage is sometimes initiated prior to incident stabilization. For example, a heavily involved fire on the second floor of an apartment complex will likely create havoc down on the first floor. The additional companies responding to the incident can be assigned to initiate Salvage operations on the first floor while the first arriving companies continue to stabilize the incident. As mentioned previously, this will be entirely dependent on the situation. Some incidents may allow these operations to begin almost immediately, such as a small fire with a lot of smoke.

SALVAGE TOOLS

OVERVIEW

Like all other tools, firefighters should be setting up salvage tools and materials for quick and efficient deployment. Be sure to know where these tools are located on the truck, how to use them, and how to maintain them for effective use. Each ladder may have these tools set up differently to match their running district.

SALVAGE BAG

Division issued yellow plastic bag containing several tools pertaining to Salvage. Most salvage bags include the following:

- Plastic rolls cut to predetermined sizes
- Box cutter
- Hammer staplers
- Spare staples

PLASTIC

Plastic sheeting is measured in mils; each mil represents one-thousandth of an inch (0.001 inch). The Division currently orders two different thicknesses of plastic; they are as shown below:

- 4-mil
- 6-mil

<u>**4-mil (0.004 inch)**</u>

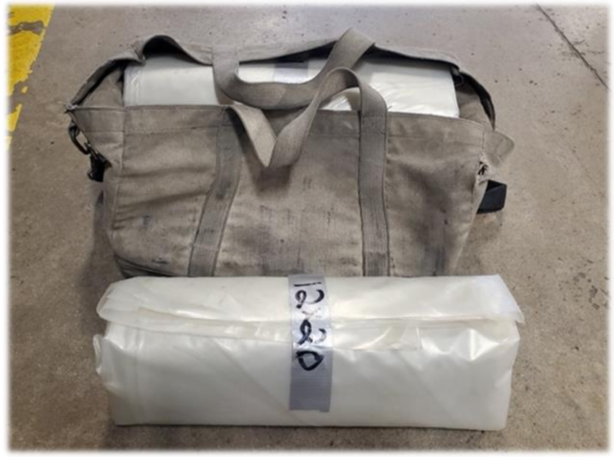
This plastic is generally utilized to cover windows. Companies should ensure the plastic is ready to go in the Division issued yellow salvage bag; this way all tasks involving covering windows or other openings can be accomplished out of this bag.

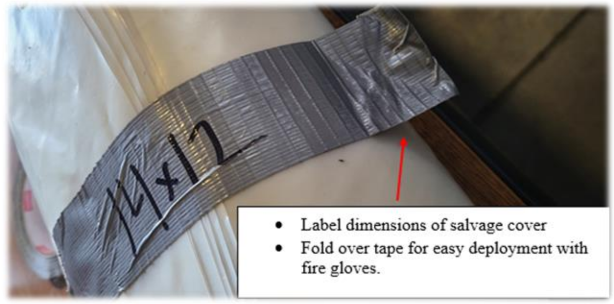
- When unfolded, this 4-mil plastic sheet is 6 feet wide

6-mil (0.006 inch)

This plastic is used as disposable salvage covers. Plastic is delivered to stations in a large cardboard box. Ladders should be proactive in cutting the 6-mil plastic to sizes that fit their district; this way pieces are already cut to roughly match their needs on a fire scene. If pre-cut pieces are marked and placed in a bag, they can then be easily taken right up to the front door.

- Unfolded 6-mil plastic is 12 feet wide
- Ensure the plastic is preset so it can be unfolded easily inside a room when needed
- The photo to the right shows a labeled pre-cut roll with a pull tab for easier deployment with gloved hands





STAPLERS

Ladders carry two different models of Slap/Hammer style staplers:

- **Arrow Stapler (Yellow)—**Only takes T50 staples
- **Duo-Fast (Black)—**Only takes Duo-Fast staples

Ladders also carry a Manual/Squeeze style stapler:

- **Duo-Fast Stapler**—Uses Duo-Fast staples (bottom right photo)

Staples should be checked during the morning truck checks to ensure they are loaded properly. Duo-Fast Hammer Staplers should be loaded to where the pull tab is not exposed (bottom left photo).

TRASH CANS AND SCOOP SHOVELS

Trash cans and scoop shovels are tools that are commonly used during overhaul, but trash cans are also a great tool for catching water dripping from the ceiling. Just be aware to not let the trash can fill up with too much water. Remember that every gallon adds 8.34 pounds of water in that can; do not let it add up too fast!

FLOOR RUNNERS

Floor runners are approximately 30” x 25’. They can be used to protect floors from firefighter’s dirty gear; consider using these when entering adjacent or uninvolved units/rooms. Floor runners can be cleaned with soap and water (hang dry).

FANS

Negative and Positive Pressure fans can be used to expel smoke; see the Equipment and Ventilation sections for more details.

SQUEEGEES

Squeegees can be used to squeegee water to accessible drains, toilet drains, elevator shafts, or other exits.

SPRINKLER SHUTOFF KIT

Can include a variety of sprinkler related shut-offs or replacement heads, depending on the truck company.

VISKLAMPS WITH S HOOKS

- Rubber ball with ring
- Used to hang plastic for various applications
- Hooks can be put through drywall or plaster or hooked over an object

CANVAS SALVAGE COVERS

Have been somewhat replaced by the plastic tarps mentioned previously; however, canvas covers are more durable against sharp objects or falling debris.

- Reusable
- Clean with mild soap and hang dry

Things firefighters can do to help themselves during salvage:

- Set tools up for success
- Start as soon as possible
- Do not leave the nozzle open when not in use
- Tighten leaking couplings

Use **common sense** as a nozzle team. For small fires that do not require a lot of water, do not create more damage than the fire did by leaving the nozzle open excessively long. A small kitchen fire that barely destroys cabinets does not need to have two inches of standing water in the basement. Again, containing the fire is the first priority.

SALVAGE FUNCTIONS

OVERVIEW

Crews are often limited only by their creativity when it comes to Salvage functions; they do not always have to be an elaborate system of tarps and hose to be effective. Firefighters may not be able to reverse most damage encountered upon arrival, but they can attempt to keep the damage from worsening. Below are some quick examples of salvage operations firefighters can perform on scene.

PREVENTING WATER DAMAGE

- Move furniture close together and cover it with appropriate size salvage covers
- Place water chutes or trash cans under light fixtures or other areas where water may possibly run
- Shut sprinkler heads or risers off
- Divert water out windows, doors, or drains
- Place personal items into drawers or other protected areas

PREVENTING SMOKE DAMAGE

- Cover objects with plastic
- Use fans to expel smoke
- Move personal items to uninvolved rooms; keep doors shut
- Find valuables at the occupant’s request and hand it to them directly

SALVAGE ON FIRE SERVICE CALLS

As previously stated, salvage goes well beyond just structure fire runs. Ladder companies are often sent on Fire Service Calls. These runs commonly involve uncontrolled water flowing into someone’s property. These problems can be as simple as a leaking toilet, or they can be burst pipes or sprinkler heads. Firefighters are not licensed plumbers or contractors and should not be attempt repair problems beyond their scope, despite their best intentions (Always recommend the occupant seek a licensed trade provider, depending on the issue). However, firefighters can attempt to isolate the issue to prevent further damage and loss for the citizen. Refer to the Service Calls and Utilities Section for information on securing utilities to prevent further damage.

STARTING THE OVERHAUL PROCESS

OVERVIEW

A ladder company's work is not over once the fire is knocked down and contained; crews will then begin transitioning into overhaul operations. Overhaul is not the most glamorous side of firefighting, but it is crucial. The biggest objective of overhaul is to prevent the word no fire company wants to hear hours after a successful knockdown: rekindle.

> ***"Overhaul is the search for hidden fire which may have the possibility of rekindling."***

Having a well-rounded knowledge of building construction is key to being successful at overhaul. Not every building is created equal. Battalion 5 may have different overhaul considerations than Battalion 2. Being familiar with the common construction types in their district and gaining experience will help firefighters when performing overhaul duties. There are some things firefighters can do to be more proactive and efficient during overhaul. As a firefighter working on a ladder company, these actions should be automatic.

Gaining experience throughout their careers will give firefighters more confidence when performing overhaul. For that reason, officers and senior firefighters should help guide the process. There are some visual cues that should tell firefighters when to open up walls, and when not to. Ultimately, it will be the officer's discretion that will dictate how much of the walls is opened up:

- Start closest to the source of the fire and work out from there
- Inspect the drywall closest to the source; an inspection hole can be made to open the wall behind it. If the wood is clean, free of discoloration, and has no charring, then the fire did not extend
- Intact drywall means fire did not penetrate; therefore, it does not necessarily need to be opened up to check for extension. Again, the experience of the officer and senior firefighters will help guide this decision. If a firefighter decides to take drywall out in between stud spaces, they should do so from floor to ceiling to ensure no embers have fallen down into the newly created voids

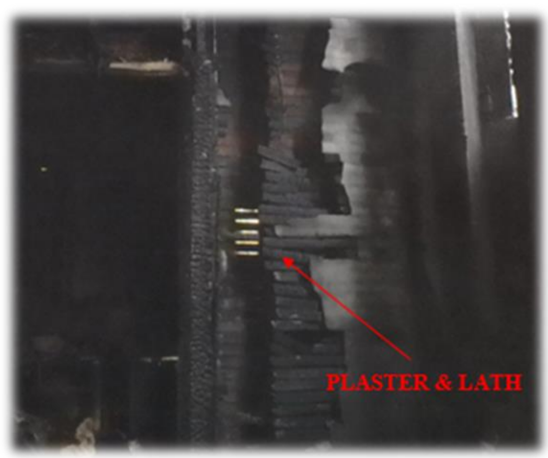
Inspect around logical areas where fire could extend—vents, wall outlets, receptacles, etc. Embers can get behind these and work their way up the wall. Dryer vent piping can allow fire spread. An external fire near the vent can also travel the piping into the structure.

“Crocodile” looking trim or baseboards should be inspected or removed. This is the wood that received the most heat, and hidden fire or embers could be present behind it.

TOOL SELECTION

A firefighter on a ladder company should have a pike pole accessible. The reach of these tools allows firefighters to pull overhead drywall immediately to check for fire extension. Columbus ladders carry a variety of pike pole lengths. Be sure to choose the right one for the job. Walking into a commercial building or an Old Victorian style home with a 4-foot pike pole will probably not be beneficial.

- For homes that have plaster and lath, a pick head axe is a beneficial tool
- Just as firefighters should be bringing salvage covers to the door, they should not forget to bring any overhaul tools needed (trash cans, shovels, etc.)
- Bring additional lighting in to give inside crews a well-lit area to work in
- Open up windows to provide natural ventilation



Positive Pressure Fans

- Ensure fans are at the door to vent the structure; introducing fresh air will cause hidden fire to show itself
- The fan not only allows fresh air to enter the structure, it also helps with removing stagnant smoke and steam post-extinguishment
- Crews can then look for any smoke that is coming from hidden smoldering materials

New York Hook

- When opening up drywall, crews can outline the desired opening between the studs using short jabs/punches with the hook, sometimes called a punch technique
- Flipping the hook around and using a D-handle can be an effective way to do this rapidly
- Once the desired opening is outlined, use the hook to pull down the ceiling; this should bring the drywall down in large sections
    - When pulling ceiling overhead, firefighters should not pull directly above themselves. Pulling out in front of them lessens the chance that the ceiling or any items stored overhead will come down on top of them
- The New York Hook can be extremely useful when overhauling. Besides pulling ceiling and drywall, the hook can be used to quickly pull door trim
- Place the angled hook an inch or two above the horizontal door, and pull down forcefully
- This should wedge the hook behind the trim. Next, rotate the hook upward to pry the trim away. The same technique can be used for the vertical trim pieces
- The chisel end can also be used for baseboards

Plaster and lath walls can be opened in large sections if desired. Create a hole in the lath and insert a tool vertically into the space behind. Pulling down and out on the tool will remove multiple pieces at once along the length of the tool.

<u>Thermal Imaging Camera</u>

The TIC is a beneficial tool during overhaul, allowing firefighters to see the differences in surface temperatures that may indicate fire is still hidden behind walls. However, the TIC is just a tool; remember that it ***<u>only reads surface temp</u>***. A wall with drywall intact reading 130° in a room that was just on fire could be normal. A wall reading 130° with no fire could mean there is HVAC ductwork within that stud space; this should point firefighters to the furnace. **Have common sense and do not get tunnel vision when using a TIC.**

TRAPPED SMOKE VS. PRESSURIZED SMOKE

Identifying the difference between these two types of smoke can be difficult initially after a knockdown; fans and horizontal ventilation can help clear out trapped smoke more quickly. It may be difficult for firefighters to differentiate between the two types until they gain experience overhauling on actual incidents. General descriptions of the two types are shown below:

- **<u>Trapped smoke</u>**—Smoke that is trapped in a space/compartment. This smoke is stagnant and will linger within a compartment until it is ventilated
- **<u>Pressurized smoke</u>**—Smoke that has some velocity to it; it may have a darker color. This is an indication that there is hidden fire somewhere in the structure

COMMON VOID SPACES

OVERVIEW

Basic knowledge of building construction is crucial on a fire scene. During overhaul, knowing where potential fire could be located based on the construction of the building will help prevent firefighters from being called back later on a rekindle. Firefighters should know their district and the challenges it provides. Common void spaces firefighters should be concerned about during overhaul are shown below.

PIPE CHASES

Common chases can run multiple floors, especially in apartment complexes. These can be in kitchen areas or in bathroom settings, and they contain plumbing or vent pipes that can run all the way to the attic or roof. In apartment buildings, kitchens and bathrooms are often built back-to-back between units. Fire reaching these areas can spread quickly and involve other rooms or units that were previously unaffected. Fire involving rooms with potential chases should be investigated quickly.

KNEE WALLS

Knee walls are common in multiple districts. Fire that penetrates knee walls can spread horizontally very quickly; these areas are often not dry walled and have no fire breaks. Tip—if a fire is thought to be knocked down but heat conditions are not improving, **open up and inspect the knee walls.** The outside ladder team should remember that venting knee walls vertically can improve inside conditions and limit horizontal fire spread.

MANSARD ROOFS/COCKLOFTS

Mansard roofs allow builders to have livable space in the attic area, without adding height to the building with a traditional attic space. Mansard roofs and cocklofts often contain a dry, open space through which fire can quickly wrap around the length of the building. Companies should be proactive in opening up mansard roofs or cocklofts to ensure the void space is clear.

BALLOON FRAME HOMES

Recognizing balloon frame construction is important when performing a size-up of a structure.

- Balloon frame construction is common in districts with older, pre-World War II homes
- Look for rectangular windows that are stacked vertically
- New homes can look like balloon frame construction, but balloon frame homes commonly have natural stone foundations

The origin of fire in these buildings can be deceiving and can potentially cause a crew to operate above a fire. The wall studs run the entire length of the structure and have open channels with no fire stops. The floor joists are also linked into the wall channels, allowing fire to spread horizontally also. For fires in this type of construction, be sure to check from the basement to the attic area. Fire can quickly spread vertically in the walls.

ATTIC SPACES

As previously stated, fire entering an attic space can be catastrophic for an occupancy. In homes with blown-in insulation, fires can spread quickly and at times even undetected. For example, small incidents involving a bathroom fan can result in firefighters having to clear a large area around the fan to ensure no undetected embers exist. Check the attic areas for extension if there is any possibility that fire penetrated that space.

ARSON CONSIDERATIONS

Overhaul is an important part of any structure fire, but consideration must still be given to preserving evidence. Crews should always try not to cause unnecessary damage through excessive overhaul, and they should be especially cautious for fires requiring an arson investigator (especially fatal fires). Crews could perform their initial knockdown and ventilation of the fire, but keep from fully overhauling the room and its contents to preserve any possible evidence. A charged handline can be kept inside with crew members to control any flare ups or hot spots, and the area can be monitored until the investigator arrives. Once the investigators have finished their investigation, crews can proceed with overhauling the rest of the structure. Ultimately, these decisions will be up to the Incident Commander and the officers on the scene.

DEBRIS REMOVAL

Crews can then proceed to removing debris and other materials using shovels and trash cans. Be aware of the weight of materials being removed; overfilled trash cans can create a significant load for firefighters to move up and down stairs. Crews should be mindful of this because the overhaul process will often take longer than the actual extinguishment, and fatigue will lead to a higher potential for injury. Large smoldering items (couches, mattresses) should be carried from the structure and placed in an area away from the building with other debris. Crews can then use a handline to douse these smoldering items without creating more water damage within the structure.

DEBRIS REMOVAL CONT.

Firefighters should pace themselves while doing overhaul; it can be a long and arduous process. This is especially true in hoarding conditions, attic spaces, extreme weather, etc. Some additional tips for overhaul and debris removal are shown below:

- Slow down
- Firefighters should use their tools for what they are designed for; firefighters should not use their hands to pull drywall
- Be out front doing the work; this is how true experience can be gained
- The officer should be leading the process, but the firefighters should be doing the work so the officer does not have to
- Ask questions along the way, learn from the process, and bring that experience gained to the next fire

Each station or officer may have a different approach to overhaul, but all have the same end goal: no rekindle! Each incident will present its own unique needs. Firefighters should ask their officers what they expect during overhaul and what their preferred methods are.

SERVICE CALLS AND UTILITIES OVERVIEW

TRUCK COMPANY OPERATIONS

SECTION TOPICS

Fire Service Runs

Natural Gas Emergencies and Response

Carbon Monoxide Alarms

Gas Monitoring and Detecting

Elevator Operations: An Advanced Understanding

Elevator Types

Basic Elevator Rescue Procedures

Securing Residential Water

Securing Commercial Water

Electrical Emergencies

Smoking Outlets and Breaker Panels

Wires Down and Pole Fires

Cutting Drip Loops

Remote Power Shut-off Options

SECTION OBJECTIVES

Understand natural gas infrastructure and common gas meter setups

Understand the procedure for investigating a carbon monoxide alarm

Understand the procedure for investigating a gas leak

Identify common elevator types and their characteristics

Understand basic elevator rescue procedures

Understand procedures for securing water in residential structures

Understand procedures for securing water in commercial structures

Understand the response procedures for wires down and pole fires

Understand how to cut drip loops

Be able to identify Smart Meters with remote shut-off capabilities

FIRE SERVICE RUNS

By Lt. Carmen DeCarlo

As the fire service run tone goes off, it does not create the adrenaline rush of a fire run. However, it is often an emergency for the person who has made the call. The situation should always be treated professionally by the Columbus Division of Fire regardless of our opinion of the seriousness. These runs are often easily handled; however, at times they can be complicated and very serious. Your actions or lack of can actually be life or death if not handled appropriately.

Some of my most memorable runs have been service runs. I have been involved with removing a raccoon from a fireplace. I have tried to fish a young lady's key from a port-a-potty with a magnet after a domestic. There have been many cats rescued from trees, rooftops, and even persuaded from a drainage pipe with a handline. My favorite was the removal of ducklings from a sewer with a shop vac. They all survived, and the mother seemed happy as they waddled away.

Firefighters from L-1 rescue stranded ducklings from a rooftop downtown

At other times, a fire service run can be much more serious. You may be dispatched on an odor investigation, carbon monoxide alarm, or a broken water line. The possibilities are endless. These all need to be thoroughly investigated. Spend the extra effort, regardless of the time of day, to determine the cause. This can prevent an embarrassing call back which often creates more property loss. More importantly, it could even result in an injury or death of a civilian. As firefighters, most crews have an assortment of different previous backgrounds. We have electricians, roofers, plumbers, HVAC technicians, and construction backgrounds among many others. Use each person's strengths to help solve the issue at hand. The officer or out of class firefighter is ultimately responsible, but does not need to make all decisions alone. The division has also supplied us with state-of-the-art equipment to assist in determining many causes. The thermal imaging camera, P400, and Sensit TKX gas detectors are a few. Be sure to use them; many times they are overlooked. There are many outside sources like Columbia Gas and the water department that are great resources. If needed, upgrade the run for more assistance from CFD. There is strength in numbers.

L-24 crew members and fire prevention members pictured with a family that had called for a CO-Alarm activation. L-24 found high CO-levels and investigated until a whole house fan was determined to be the cause, drawing back in expelled CO from the furnace. These CO detectors had been installed earlier in the day by prevention members, avoiding a potentially deadly outcome for the family.

Lastly, service runs often involve lockouts and wellness checks. In my opinion, these create a special challenge for us. Whether a person is locked out of a house or car, they need to be able to prove this is their property. If they cannot, you may have to involve the police department to confirm identity. Be sure to explain before entry you could cause damage and that they understand and agree. Of course, start with the least damaging way to gain access. Fill out any forms necessary and have them sign if appropriate.

The photo on the right shows a Ladder company drilling a lock to gain access to a resident who had fallen on the floor and needed assistance. Since the patient was talking and not in distress, crews opted for this method rather than conventional irons to force the door.

A third-party wellness check can be a very dangerous run. You could be forcing your way into a structure and surprising the occupant. Be sure to investigate thoroughly. Do not be hesitant to involve the police, battalion chief, and an EMS coordinator if necessary. Take all precautions to protect yourself and the crew. It may be appropriate to don a ballistics vest and helmet beforehand. Announce “Columbus Fire Department” while loudly knocking on the door. A firetruck parked outside with lights on may also help the occupant understand who is at the door. As a last resort, respectful forcible entry could be used. Once entry is gained, the police department can enter and secure the scene. If they find an occupant, we can then enter and provide care.

Regardless of the type of service call, always be a professional. Treat people as family members and you will not go wrong. Spend a few extra minutes to help clean up. Squeegeeing water, replacing door trim, and replacing detector batteries is easy to do and goes a long way. Work together as a team and think outside the box to solve the issue at hand. Most importantly, be safe out there.

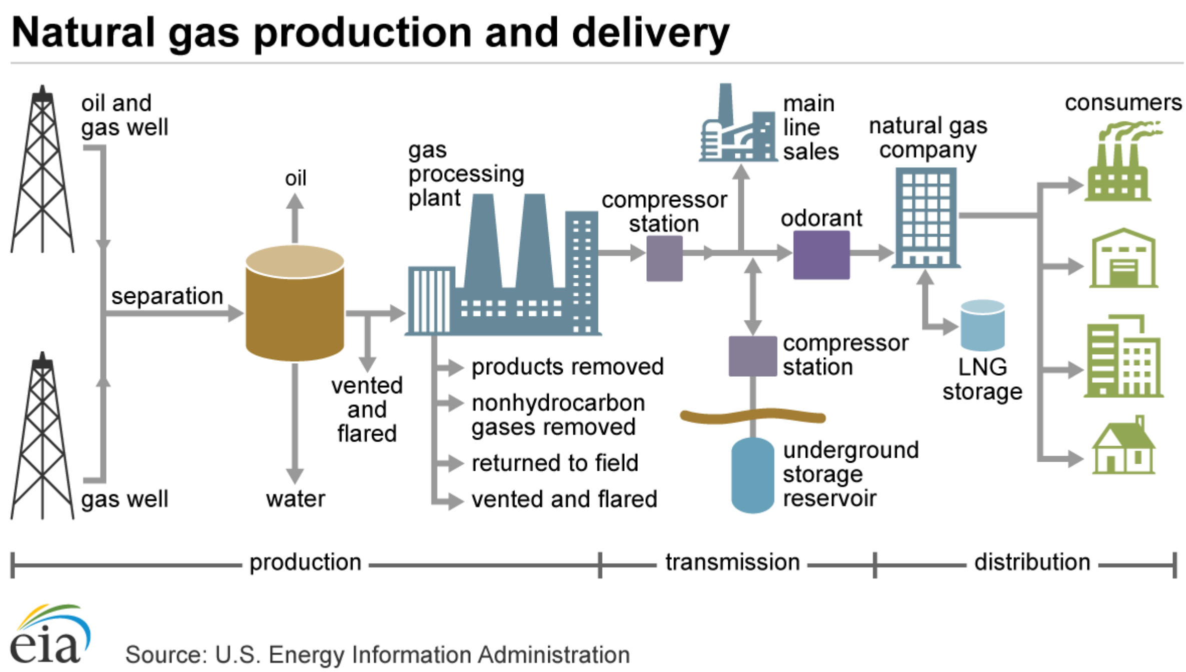
NATURAL GAS EMERGENCIES AND RESPONSE

OVERVIEW

What is natural gas? Natural gas is a fossil energy source that forms deep beneath the earth's surface. Natural gas contains many different compounds. The largest component of natural gas is methane, a compound with one carbon atom and four hydrogen atoms (CH4).

Natural gas delivery infrastructure can be grouped into three categories:

- Production
- Transmission
- Distribution



LINE OPERATING PRESSURES

As firefighters on scene, the operating pressure is something that we generally assume in relation to its sound. If you can hear it blowing from blocks away, it is safe to assume that it is elevated pressure. Operating pressures may vary depending on the area of town you are working in. Several factors play into the amount of operating pressure needed for a particular area, all of which are decided by the local gas company. Below are operating pressures that may be encountered:

- **Low Pressure:** Up to ½ pound of pressure
- **Medium Pressure:** 10-60 psi (can drop to 2 psi during periods of full demand)
- **High Pressure:** Anything exceeding 60 psi

SPECIFIC GRAVITY

When investigating a potential gas leak, consider that natural gas has a specific gravity of .60-.70. For reference, the specific gravity of air is 1.0. What this means is that natural gas is lighter than air and will rise into the atmosphere. It will dissipate rapidly outside. Inside of buildings however, it tends to pocket itself particularly in attic spaces, under stairs, and in any dead spaces within the structure.

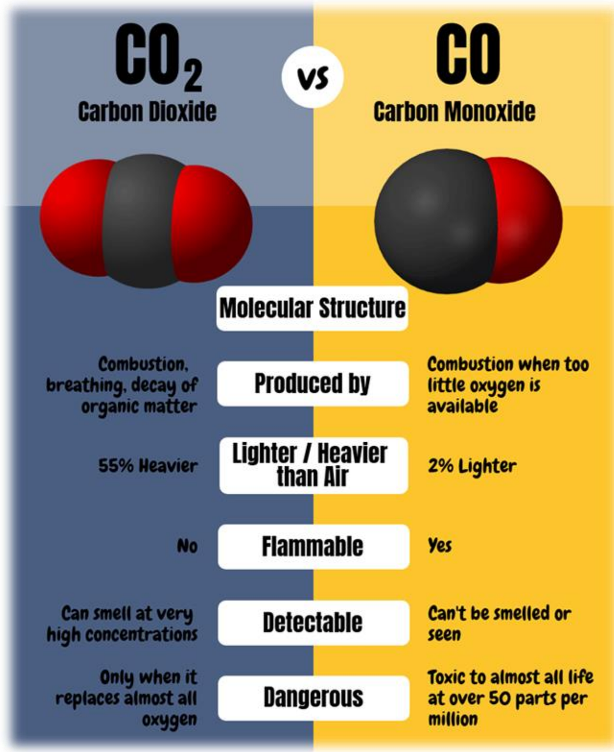


Diagram from Patrick Barnhart's article Carbon Monoxide Poisoning

Just for thought: Think about investigating a possible natural gas leak in your local Auto Dealership. Many of these occupancies have very high ceilings, and the gas could be collecting in an area much higher than that of a firefighter with a gas monitor walking around at ground level. A large majority of fire department's natural gas response will fall under the distribution and delivery portion of the system that goes to residential and commercial users. The City of Columbus does have some underground transmission lines and regulator stations that can produce odors calls. A vast majority of odor calls will come from residential and commercial users.

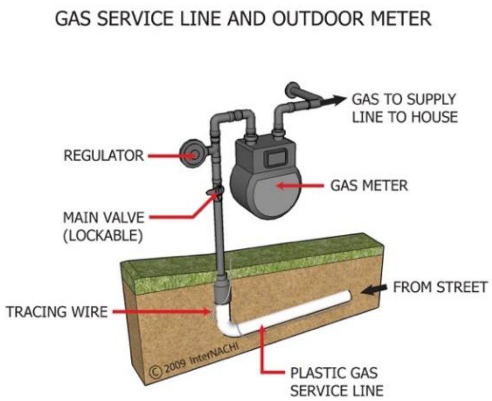
NATURAL GAS SERVICE FEEDS

In a typical natural gas delivery system to a commercial or residential structure, the natural gas flows from the main line through a tap, then feeds the service line. Most systems will have a flow control valve. It will either be a curb shut off valve or an excess flow valve on the service line near the main. Some low-pressure systems will not have a flow control valve near the main, but this can only be done when the gas meter is located on the outside of the structure. Any system with a gas meter located inside the structure is required to have a curb shutoff valve near the main.

Gas meters can be found inside or outside of a structure. Currently gas companies are trying to get all gas meters moved to the outside of any structure. Many residential homes still have gas meters in the basement. If a meter is located inside a structure, there will be a shutoff valve on the meter setting and a curb shut off valve near the main line outside the structure. This shut off can be located by finding the "curb box". It is typically located in line with the meter riser near the main line. The Rescue Companies are equipped with Subsurface Magnetic locators that can assist with locating the metal curb box lid. It must be noted that the Gas Company does not advise shutting off any underground valve without ABSOLUTE certainty that the valve that is being turned feeds the line that needs to be shut down. There can be serious hazards associated with turning underground valves, and this action is considered beyond the level of training for a 240 firefighter. Curb keys are located on Ladder and Rescue companies, but they are not to be used unless you are sure that you will have the expected/desired outcome.

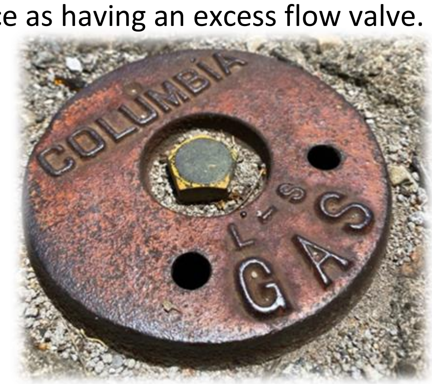
GAS METER SETUPS

Natural gas meter settings can come in a variety of configurations. Below is a basic single meter setting. Notice there is a shut off valve below the regulator. This is the inlet side of the setting. The regulator reduces the amount of pressure being delivered from the main into the occupancy. Most house lines inside an occupancy will operate on less than a pound of pressure. The red circle below indicates the quarter turn shut off valve from the service line used to turn off the gas to the structure. Also note that many meters will have a yellow wire coming up out of the ground and appears to be loose at the base of the feed line. These yellow wires are used as tracer lines to locate the underground pipes by service providers.



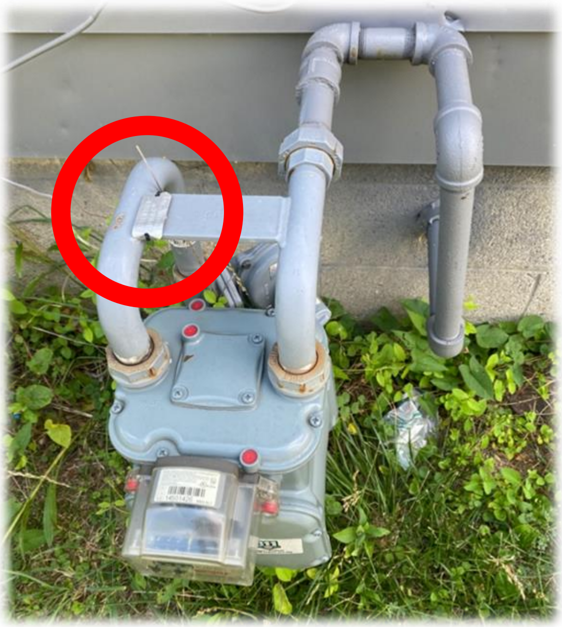
CURB BOX LID

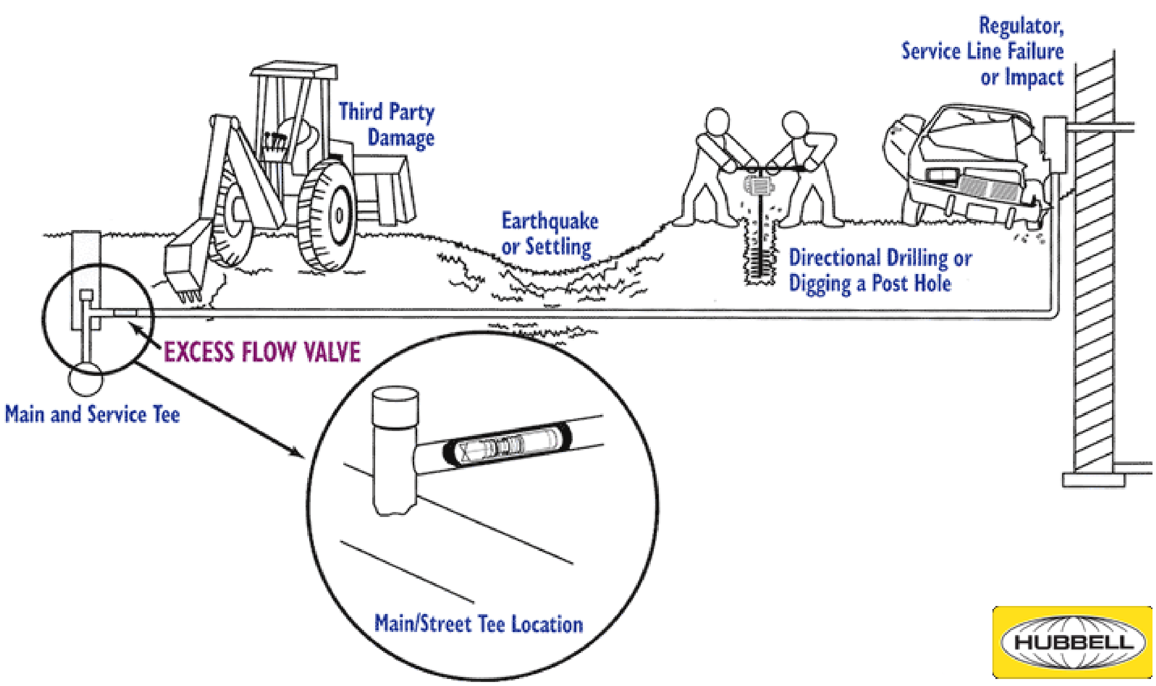
These may be found in the yard, sidewalk, driveway, alley, or may be missing altogether after a previous excavation. If the gas meter is located outside of the structure, it may not have a curb valve shutoff with a curb box lid located near the main. Instead, it may have an Excess Flow Valve. This will be identified by a military style dog tag zip tied to the meter setting identifying the service as having an excess flow valve.



EXCESS FLOW VALVES

- EFVs are designed to automatically restrict the flow of natural gas if a service line is damaged or broken
- Does not provide complete shut down by its design, will allow small amount of gas to "seep"
- Will automatically reset once repaired and pressure equalizes on both sides of valve
- **DO NOT** bend over and damage service lines, this can cause friction and lead to sparking. Bending the line also has the potential to reset the EFV back to full pressure
- The military style dog tag will be zip tied to the meter indicating the presence of an EFV. The red circle below highlights a tag on a meter in Columbus





CSST MANIFOLDS

An exception to the low-pressure house lines is when CSST (corrugated stainless-steel tubing) is used. In this example, elevated pressure is delivered to a centrally located manifold and regulated down at this location.

MULTI-UNIT FEEDS

The photo below shows a multi-unit apartment setting. Notice there are individual shut off valves for each individual meter on the inlet side of each meter. Some meters may have the apartment numbers located appropriately on the associated meters; others may not. When working on an emergency scene, many times it may be faster to turn off the whole multi meter setting by using the shut off valve located on the riser below the regulator. To turn off the entire multi meter setting, simply locate the inlet piping coming from the ground (Riser) and use the quarter turn valve to shut off the service line feed, much like a single meter setting.

Multi-Meter Manifold settings may be difficult to determine which meter goes to the occupancy that you are trying to shut the gas off to. Some meters in a multi meter manifold setting may be marked with the address or apartment number in some fashion by the gas company. This can be done with individual tags on each meter or the address just being written on the meter with a permanent marker. Notice in the photo below there is a regulator which indicates the inlet side of the setting. Below the regulator is a ¼ turn shut off valve that will shut off the gas flow to the entire meter setting. Depending on the seriousness and nature of the emergency, it may be necessary to shut off the entire meter setting off.

CARBON MONOXIDE ALARMS

OVERVIEW

Let's be honest, responding to a CO Alarm does not create the type of excitement many of our other runs do. We always try to guard against complacency, and if ever there was a type of run that should heighten one's awareness it is the CO run. CO is a colorless, odorless, and tasteless toxic gas that kills Americans across this country every year. Carbon Monoxide is produced as a result of incomplete combustion of carbon-based fuels, including wood, natural gas, propane, oil and kerosene. In reality fuels never burn completely, and as a result carbon monoxide is routinely produced in the home. When appliances are operating properly and vented correctly, these toxic gases are produced at low levels and expelled to the outside of the structure. Not all appliances are vented to the outside. Using an unvented fuel burning appliance in the home can reduce the oxygen level, and the reduced O2 supply will cause an increase in the production of CO. Some of these appliances use an oxygen depletion sensor to prevent the formation of CO. If the oxygen is sufficiently reduced, the appliance shuts off. Again, we are relying on a properly functioning safety device that may or may not have been properly maintained.

CODES AND THE EXPERTS

Much like the NFPA standards that guide us as firefighters, there are National standards and State codes that govern the use and installation of carbon-based fuel appliances. These codes include everything from the size of venting, how far the venting needs to extend beyond the roof line, to the size of room an appliance can be in without additional combustion air ventilation. The next time you are in an apartment with a utility closet that houses a furnace and hot water tank, look for register style vents high and low that open up to an adjoining room. These vents help to allow for combustion air and are required by code for that appliance to properly function. Without these vents the appliance would not have the proper amount of combustion air and would produce excessive amounts of carbon monoxide. The reason I bring this up is not for you to feel the need to learn the Standards and Codes for carbon-based fuel burning appliances, but instead for you to realize there is a lot we as firefighters do not know when it comes to CO producing appliances. Remember why you are there! Make sure everyone is safe, and if needed gets the medical treatment they need. After that, we can worry about how to move forward with our attempt in finding the source (per our SOP). Do not hesitate to ask for assistance from Columbia Gas when trying to determine the source, even at lower levels. Truth be told, it seems to be more difficult to determine the source when you are trying to find the source at lower levels.

ARRIVING TO THE SCENE

Upon arrival of a CO run, it is important to speak with the occupant and find out if anyone has been sick with flu like symptoms—headache, confusion, fatigue, nausea, etc. Not just the occupant that you are speaking with, but all residents of the home. The Maryland Institute for Emergency Medical Services has reported that they have received patients with blood carbon monoxide levels of less than 5% who were comatose, and others with blood carbon monoxide levels of 50% who were ambulatory and speaking. Point being, CO can have an effect on people differently. Ask about any appliances they have in the home. Are they gas or electric? Were any of the appliances running at the time of the alarm? These are common questions to be asked, and they give you a good starting point when trying to determine the cause of the alarm and source of CO. But what if it is the middle of summer and the occupant states the only gas appliance is the furnace and that it had been shut off? Or what if they tell you it is an all-electric home? Much like doing a patient assessment on the medic, we now have to dig a little deeper. I have experienced CO readings more than 35 ppm caused by smoldering embers from a Hookah pipe, smoldering ashes in a metal bucket from a clean out of a wood burning stove, and in a residential duplex where the neighbor was running a gas-powered power washer in the basement of the unit next door. Another consideration when investigating CO runs is whether or not the resident ventilated in any way prior to your arrival. Imagine not having any readings on our 5-gas monitor (P-400) upon arrival because the resident opened all the doors and windows before you got there. You should be able to see where I am going with this. We have got to maintain a high level of suspicion and not get complacent.

THE INVESTIGATION

When trying to determine the source of CO, a good practice is to first shut off all appliances and ventilate the structure. Shutting off all gas appliances does not mean turning off the gas. It means turning the controls down so the controls are not calling for heat. Ventilating may be difficult. Many of these structures may be cut up and require some coordination using fans from a Ladder Company. Much like ventilating smoke, doors may have to be opened or closed in different areas of the residence to effectively remove the CO. Once all the CO has been removed from the residence, we can now start checking each appliance individually. As an example, we will first check the hot water tank: Turn the appliance on. This can be done by running some hot water from a sink for a few minutes until the controls call for heat and the main burner comes on. Another option would be to turn the thermostat up on the hot water tank to get it to call for heat. Prior to doing this pay attention to where the homeowner had it set, so it can be turned back to their desired temperature after checking the appliance. Using the P-400, check around the water heater and heating unit. Also check along the flue pipe, paying particular attention for any CO escaping due to a down draft around the draft hood. Any holes or rust in the flue pipe should be of concern. Look for soot on the top of the hot water tank around the draft hood. This would be an indication of the flue gases not properly venting to the outside. Some newer hot water tanks will have a forced vent rather than natural vent system. These types of systems will have a plastic vent pipe with a fan attached on the hot water tank itself. This fan forces the products of combustion to the outside rather than the hot gases rising naturally to the outside.

A properly vented hot water tank should draw the smoke from a match up and out of the vent as shown in the picture.

A furnace is checked in similar fashion. It too can be a forced vented system, or in older models a natural vented system. Again, check the flue pipe and around the area where it connects to the chimney. Look for rust or any holes in the venting and make sure the vent pipe is securely connected. One major difference when checking the furnace is we MUST check the heat registers throughout the residence while the furnace is in operation producing heat. If the furnace were to have a cracked heat exchanger, the flue gasses can escape into the heating ductwork and be spread throughout the home by way of the registers. This condition becomes deadly when occupants go to bed at night, shutting their bedroom doors and confining themselves in a small bedroom. The CO is pumped into the room as the furnace warms the room via the registers. A cracked heat exchanger can sometimes be identified by observing the flame of an operating furnace. A properly adjusted and operating heating system should have a blue uniform burning flame. One with a cracked heat exchanger will have an orange flame that is dancing around with no uniformity. A blue flame on a gas fed appliance indicates that it is adjusted properly with the right amount of fuel to air mixture.

Gas stoves are difficult to determine if they are the cause of a CO alarm. They generally are not vented to the outside. When an oven is first turned on, it will produce higher than normal CO readings. This is due to the flame impinging on the cold heat shield above the burner. Allow the oven to warm up to near operating temperatures before determining that it may be the cause of the CO alarm. To the right is a picture of an oven burner and flame impinging on the heat shield.

These are just a few of the examples of the major gas appliances found that can produce CO in a home. Understand this is just a brief description of how to check the appliance to determine if it is the source of a CO alarm or CO readings found in a home. Again, Columbia Gas is your best friend in these situations, if for nothing more than to confirm your suspicions. Other sources of CO could be, but not limited to, a gas dryer, gas or wood fireplace, space heaters, a blocked chimney, or a vehicle running or started in a garage.

SUMMARY

This information is not intended to replace The Columbus Division of Fire's existing Standard Operating Procedure 02-03-09. Instead, it is to help you better understand how to follow it. It is very important that you read and understand SOP 02-03-09, as it will guide you in your actions to the different levels of CO. As a reminder, Form FP-356 is a great tool to use when on the scene of a CO run. It reminds us of some of the symptoms a person exposed to CO may have, along with a list of several appliances to be checked and some actions you should take at different levels of CO detected.

GAS MONITORING AND DETECTING

EQUIPMENT

Sensit P-400 (monitor) and the Sensit TKX (detector) are state-of-the-art personal gas devices used to alert users of potentially hazardous gases in the work area. They both can be found on engine, ladder, and rescue companies. Both should be used together on a natural gas response because the TKX has a higher sensitivity rating and may give an earlier warning to the presence of natural gas than the P-400. In this study, we are going to discuss specifically the P-400 as it relates to a natural gas leak response. It is highly recommended that you seek further instructions on these tools, as both have their advantages. Equipment write ups for both can be found in the Out of Class Manual Equipment Section.

The P-400 monitor has 5 sensors:

- O2-Oxygen
- Ch4-Combustible Gas (LEL Only)
- CO-Carbon Monoxide
- H2S-Hydrogen Sulfide
- HCN-Hydrogen Cyanide

P400 ALARM LIMITS		
	LOW ALARM	HIGH ALARM
O2	19.5%	23.5%
CH4	10% OF THE LEL	20% OF THE LEL *(50% FOR HIGH/HIGH ALARM)*
CO	35 PPM	70 PPM
H2S	10 PPM	20 PPM
HCN	4.7 PPM	10 PPM
CH4 = METHANE		CO = CARBON MONOXIDE
H2S = HYDROGEN SULFIDE		HCN = HYDROGEN CYANIDE

CHEMICAL MAKE-UP

As mentioned earlier, the largest component of natural gas is methane, a compound with one carbon atom and four hydrogen atoms (CH4). When monitoring for a combustible gas with the P-400, you will be observing the CH4 numbers on the graphic display.

WHAT IS THE METER TELLING ME?

Now let's discuss what the numbers on the graphic display mean when you get a reading of CH4 in an environment that has natural gas. Natural gas has an explosive (flammable) concentration range between 5% and 15% gas to air. At concentrations below 5% or above 15%, natural gas will not burn. 5% gas is the lower explosive limit (LEL) and 15% is the upper explosive level (UEL). You MUST understand that the Sensit P-400 will only read the percentage level of the LEL (That is the percentage of 5%). So, if you were to look at the graphic display and you saw 100% of CH4, that is telling you that you are at least the 5% (LEL). You could be in the 5-15% explosive range or even above the 15%, in which case it would be too rich to burn. Let's look at another example: CH4 reads 50%; this means that you are at 2.5% natural gas to air, halfway to the LEL of 5%. This may seem a bit confusing, but understand we want to avoid putting ourselves into an explosive environment. Knowing where we are in relation to the LEL gives us the best chance of staying out of the IDLH environment. The P-400 will start to alarm at 10% of the LEL. Keep in mind that if you are getting any CH4 reading where you are standing, somewhere in that structure could already be in the explosive range.

PEAK MODE

The P-400 monitors carried on the rescues are slightly different in that they have a “peak hold” mode used in confined space and an auxiliary pump that allows air samples with a probe or hose assembly. Something else to consider is that the P-400 reads in % of LEL. Some mutual aid departments and at times the gas company use meters that read in PPM (Parts Per Million). This can create some confusion with Columbus companies. Below is a chart that shows the relationship between PPM and %LEL. Note 100% of the LEL and 50,000PPM are both equivalent to the LEL (5% gas).

CONVERSION CHART FOR METHANE (NATURAL GAS)

%LEL	PPM	%GAS	
0.1	50	0.005	
0.2	100	0.010	
0.3	150	0.015	
0.4	200	0.020	
0.5	250	0.025	
0.6	300	0.030	
0.7	350	0.035	
0.8	400	0.040	
0.9	450	0.045	
1.0	500	0.050	
2.0	1000	0.100	
3.0	1500	0.150	
4.0	2000	0.200	
5.0	2500	0.250	
6.0	3000	0.300	
7.0	3500	0.350	
8.0	4000	0.400	
9.0	4500	0.450	
10	**5000**	**0.500**	**OSHA ALARM**
15	7500	0.75	
20	10000	1.00	
25	12500	1.25	
30	15000	1.50	
35	17500	1.75	
40	20000	2.00	
45	22500	2.25	
50	25000	2.50	
60	30000	3.00	
70	35000	3.50	
80	40000	4.00	
90	45000	4.50	
100	50000	5.00	

THE CALL AND RESPONSE

The actual dispatch that goes out is simple. It is a "GAS LEAK." There are multiple reasons why someone may have called 911. It could be an odor inside or outside of the occupancy, something as small as a pilot light out on a range or as large as a contractor hitting a line with elevated gas pressure blowing. It is important to keep a heightened sense of awareness on all responses, especially natural gas leaks. Natural gas leaks can turn deadly without warning. Imagine being on the scene investigating a potential gas leak with no odor or readings on the P-400 and having the whole building explode off of its foundation without warning. It is impossible to discuss every type of gas leak that may be encountered, but we will discuss a few.

The first one will be an inside leak. The concerning factor here is the enclosed environment. This allows the gas to build up and possibly enter its explosive or flammable range. The other concern of an inside leak is the unknown area of the leak. Firefighters could be walking around trying to investigate and in the immediate area they are checking there is no odor or readings, but somewhere inside of the structure there is an explosive environment waiting for an ignition source. Some ignition sources could be a furnace or water tank cycling on in a utility closet or a light source waiting to be turned on.

Next, we will discuss the outside leak. Many times, this could be caused by a small leak on an outside meter setting or even a setting that has been hit by a vehicle. A common outside leak involves a line hit by a construction contractor. Many times, a contractor may hit a line with a hand tool, backhoe, or even worse a directional bore machine. Of the many ways a contractor may hit a line, by far the most dangerous is the directional bore machine pictured below.

When a gas line is hit by a hand tool or backhoe, the escaping gas will generally rise into the environment and dissipate rapidly. There are concerns that if close to a structure this gas could be getting into the structure though windows, doors, ventilation systems, etc. In any situation, gas follows the path of least resistance. The path of least resistance is what makes the directional bore machine incident so dangerous. When a gas line is hit underground with a directional bore machine, the path of least resistance is not up and dissipating into the atmosphere. The pathway is normally underground along existing utility lines such as water, sewage, and electric lines of conduit. The problem now becomes where is the gas going? It could be building up against the foundation of a structure somewhere, or finding its way into a structure by way of another utility such as a sewer line. It is important when investigating a gas leak where a directional boring machine is involved that manholes and sewers are checked for the presence of natural gas in the surrounding areas. This will assist in setting up your cold zone of operation and identifying areas that may need to be evacuated.

The call comes out as a gas leak. While enroute to the scene, it is important to obtain as much information as possible about the nature of the leak. Many times, this may only be the remarks on the MDC. Pay attention to the radio traffic from first arriving companies. Many times, this will help incoming companies paint a picture of the severity of the leak. It can also determine your company's approach based on wind direction and the need to possibly block traffic. It cannot be overstated the importance of full PPE when investigating a natural gas leak. This means everything including gloves and hoods. If that unexpected explosion occurs, full PPE may be what allows you to survive the blast and have a faster recovery. See SOP 02-03-13 Gas Leak Response. As you read and study it, think about how it applies to all the situations discussed. Inside and outside leaks, backhoe and directional bore machines, and any gas leaks that you may have previously responded to.

ELEVATOR OPERATIONS: AN ADVANCED UNDERSTANDING

OVERVIEW

Elevators are commonly associated with the high-rise buildings dotting the skylines of our major metropolitan cities across the United States; they are relied upon by thousands each day as they are utilized for access for business, industry, and residential applications. The prevalence of elevators has drastically increased in the last thirty years due to the Americans with Disabilities Act of the early 1990s, which now requires most public buildings with more than one story to have an elevator. What was once just a common run type experienced by CFD downtown companies is now a discipline which permeates all areas of our city. Given this context, firefighters must be competent in their ability to identify various elevator types, understand their general schematics and components, and apply this knowledge and associated concepts to start the rescue progression. This does not mean firefighters need to be "Elevator Technicians"; however, firefighters should have an above average comprehension of how elevators work, how they fail, and how they could potentially endanger rescuers or the surrounding public.

HISTORICAL PERSPECTIVE

The modern-day elevator is the invention of Elisha Otis. Perhaps this name sounds familiar; Otis Elevator Company is the world's largest manufacturer of elevators. Mr. Otis' 1853 invention of the safety elevator (which consisted of interlocks that kept the elevator from falling its entire height if the cables snapped) at the New York's World Fair laid the foundational groundwork for the elevator industry to gain traction and credibility as a means for transporting people and equipment vertically within a building, and allowing architects to no longer be confined regarding building height and size. This invention served as the catalyst for the creation of the high rise building which all firefighters are familiar with.

CONTENT

- Elevator Types
    - Electric Cable or Traction Elevators
    - Hydraulic Elevators
    - Machine-Room-Less (MRL) or Direct Drive Elevators
- Basic Elevator Rescue Procedures

ELEVATOR TYPES

OVERVIEW

- Elevators have evolved drastically from their original rudimentary inception, like the one pictured on the previous page
- Elevators can be classified into three very basic categories based on their specific mechanical driving system. Those three categories include the following:
    - Electric Cable or Traction Elevators
    - Hydraulic Elevators
    - Machine-Room-Less (MRL) or Direct Drive Elevators

ELECTRIC CABLE OR TRACTION DRIVEN ELEVATORS

- If you have ever seen the movie *Die Hard*, then you have most certainly seen an electric cable or traction elevator
- These are the elevators which are commonly associated with the high-rise buildings downtown. These types of elevators are generally found in taller buildings (more than six floors on average)
- Consists of a car, hoistway, cables, electrical motor, winding drum, counterweights, brakes, and electrical equipment
- Mechanical room is typically found at the roof or in a penthouse; however, there are also traction elevators with a mechanical room located at the ground level or in the basement

This is an Otis traction elevator system located at 1445 E. Broad Street

This is a traction elevator system located at 155 E. Broad Street (PNC Building)

Traction Elevator

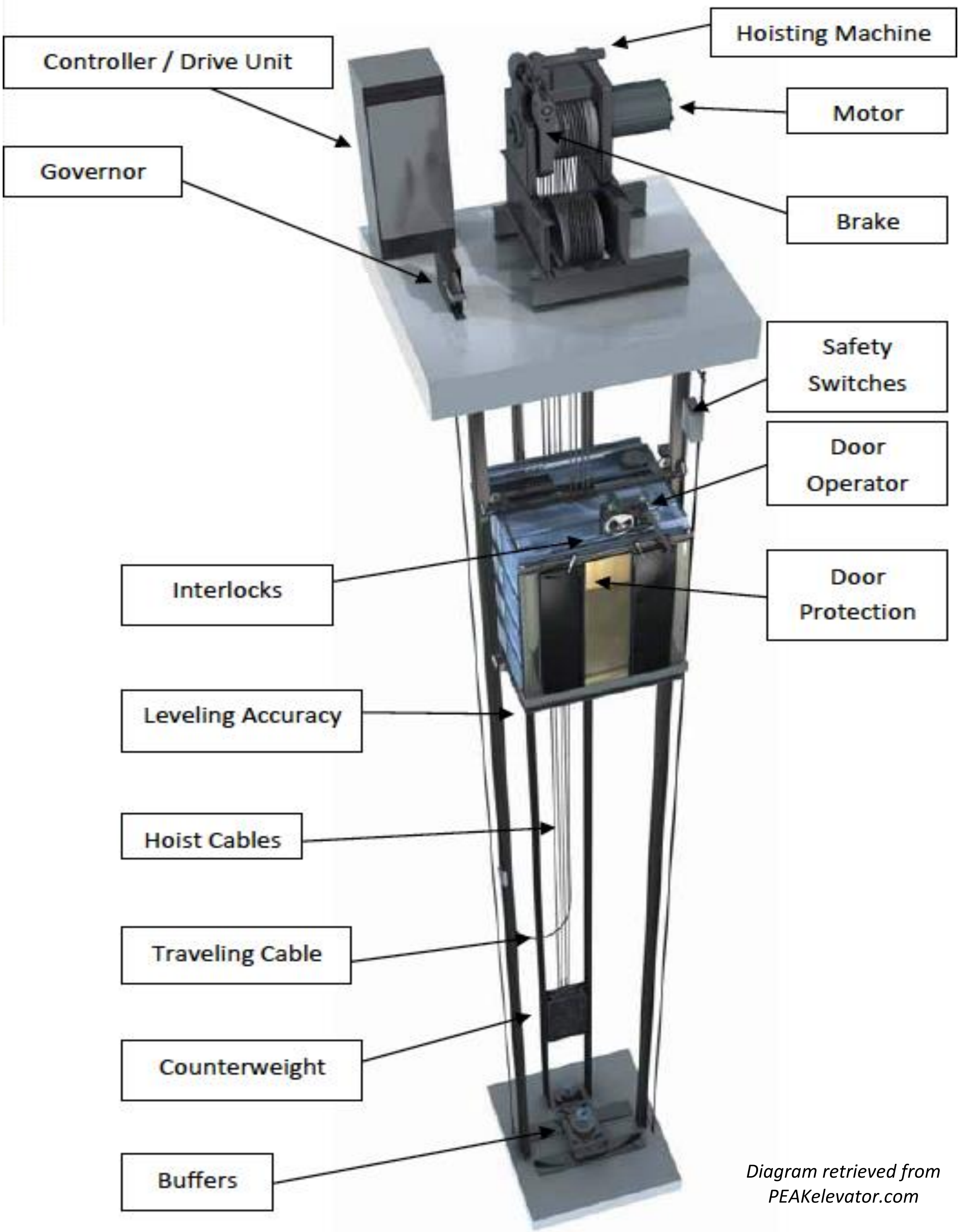


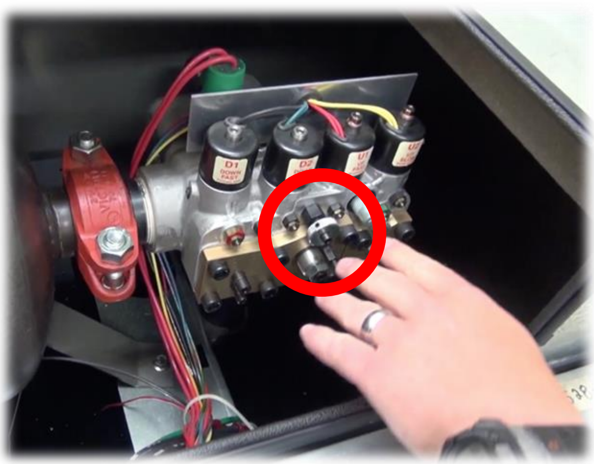
Diagram retrieved from PEAKelevator.com

HYDRAULIC ELEVATORS

- These elevators are very common in low-rise and mid-rise buildings
- These elevators are a very popular option for building owners because they are efficient and relatively easy to maintain
- Consists of a car, hoistway, hydraulic cylinder and power unit, counterweights, brakes, and electrical equipment
- Machine room is typically found in the basement or in the lobby adjacent to the elevator
- Generally limited to six stories; however, they can go up to ten stories

This is the hydraulic pump manifold from 170 E. Town Street

This is the hydraulic equipment room at South Campus Gateway Parking Garage



This is the valve manifold inside the pump unit for the hydraulic elevator at the TA. The red circle shows the knurled drift knob that can be used to release and lower the elevator

This is the bottom of the elevator shaft of the Training Academy hydraulic evaluator. Pictured is the main plumbing coming in from the reservoir to both multistage lift cylinders

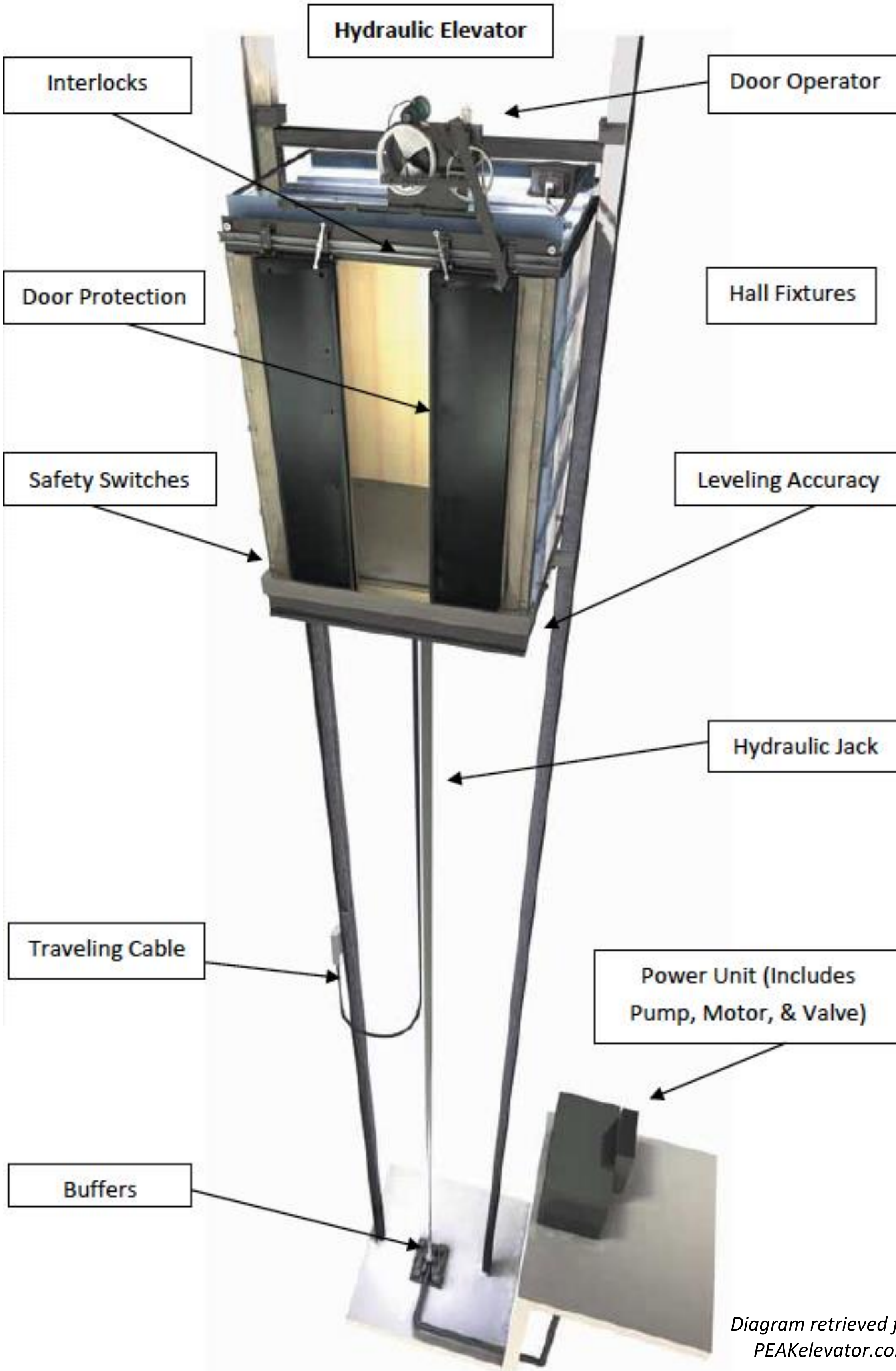


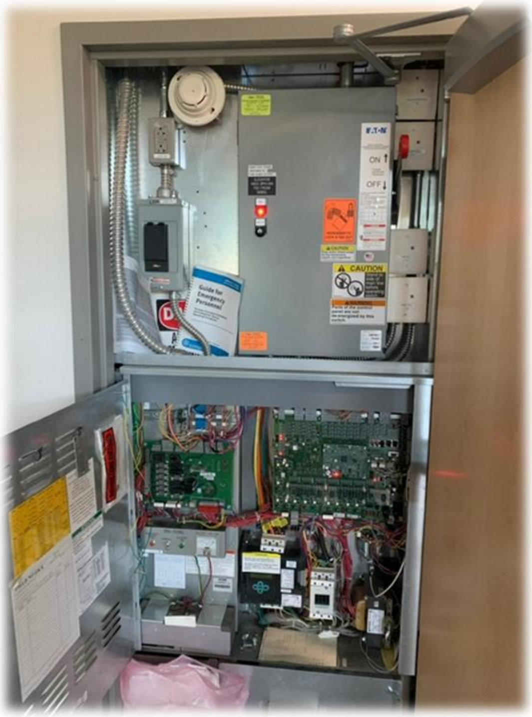
Diagram retrieved from PEAKelevator.com

MACHINE-ROOM-LESS (MRL) OR DIRECT DRIVE ELEVATORS

- Machine-room-less (MRL) elevators do not have a dedicated machine room (MR)
- The machine sits in the overhead space on a traction unit and is accessed from the top of the elevator cab when maintenance or repairs are required
- The control panel can be difficult to locate, since there is no one location they are typically placed. These control panels can be on any floor behind an access panel or door. However, they typically will share a common wall with the elevator shaft
- The drive mechanism is in the pit on hydraulic units
- MRL and Direct Drive elevators can utilize belts, rope, cable, or hydraulic cylinders for moving the car up and down throughout the hoistway

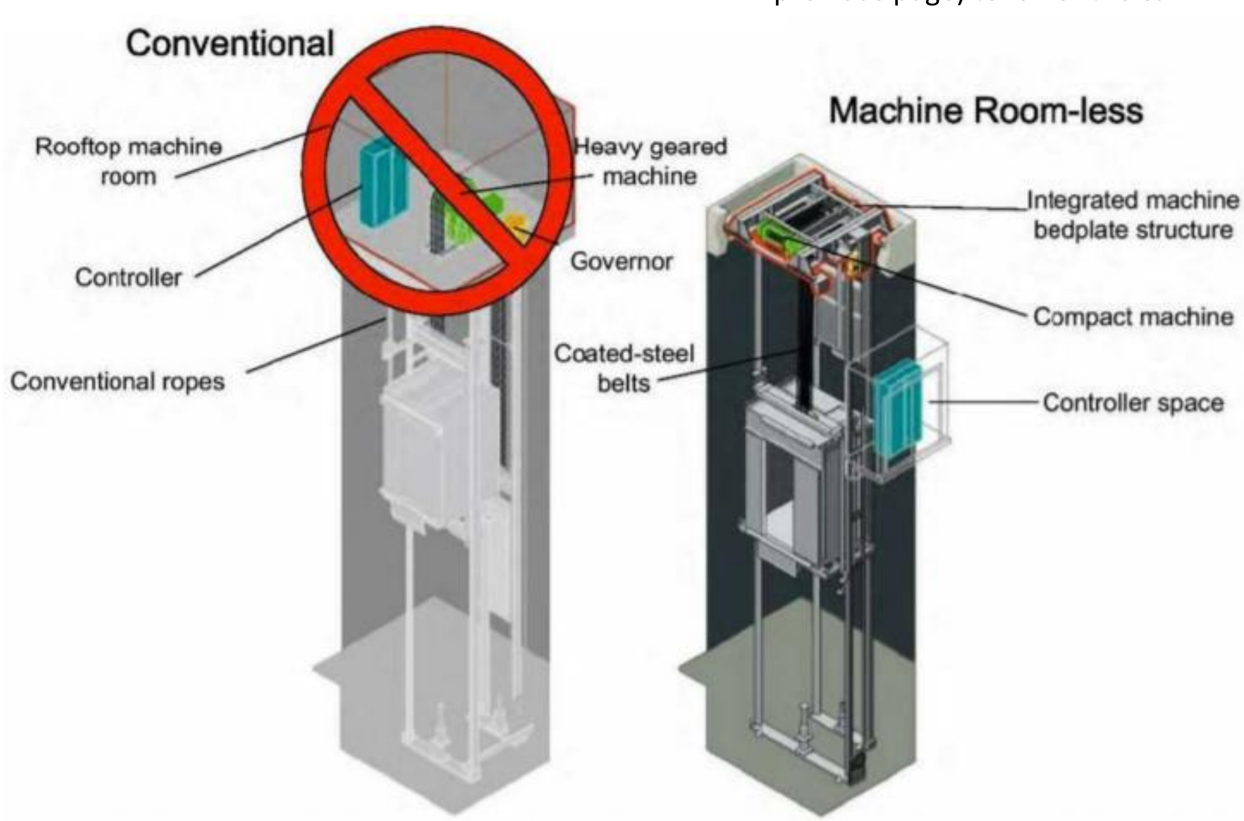
This shows the counterweights, guiderails, and drive belt built within the hoistway of a residential MRL elevator

This shows the motor located at the top of the shaft with a metal manual override rod inserted into it. This rod can be used to lower and raise the car by hand



This shows the elevator machine "room" for a hydraulic driven MRL system

This shows a firefighter using the manual override rod (see photo on previous page) to lower the car



This shows a conventional vs MRL elevator. This diagram is from the City of Phoenix Planning Department

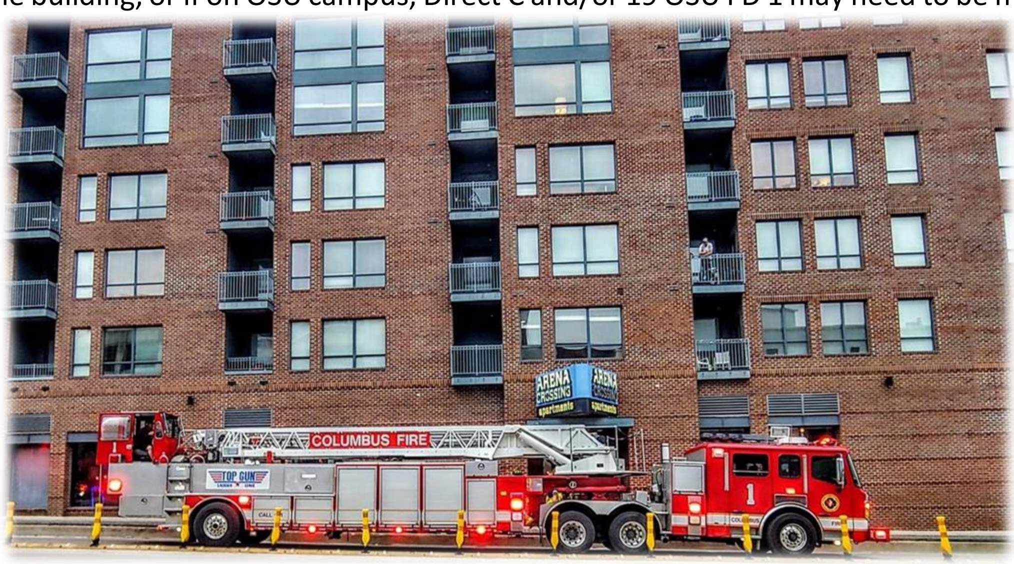
BASIC ELEVATOR RESCUE PROCEDURES

OVERVIEW

- Elevator rescues range from extremely simple to complex
- There are so many different types of manufactures and designs that an attempt to discuss all of them in this section would not be feasible
- This section is not a comprehensive elevator rescue guidebook; it is simply an overview of basic procedures and steps to take while working through a rescue. These steps will not always be performed in the same order on every run
- The status of the occupant trapped will play a large role in the progressions the on-scene crews will choose to take

ARRIVING ON SCENE: RECON

- When the first company arrives on scene, they will begin their recon process
- Make contact with the caller or building maintenance personnel; they will usually be the best source of information
- Determine if an elevator is inoperable; if so, determine which elevator is affected
- Determine the location of the elevator within the hoistway
- Are any occupants trapped? If so, are they injured?
- Notify an Elevator Technician
  - Whether firefighters get the person out or not, the elevator in some way, shape, or form has malfunctioned and should be inspected. Typically, this responsibility falls on the building owner. Asking maintenance and/or the building owner if they have made contact with an elevator technician is a great start
  - OSU Campus has hired an elevator technician that should be able to respond within thirty minutes to any OSU owned facility
- Determine the type of elevator and the location of the machine room
- Ensure every member of the crew is on the channel assigned by the FAO. Depending on the building, or if on OSU campus, Direct C and/or 19 OSU FD 1 may need to be monitored



INITIAL ACTIONS

- Determine the type of elevator and the location of the machine room
- Send at least one firefighter with a radio to the machine room to control power
- Send a crew with tools to the floor where the elevator is stranded
- Keep a crew member on the floor of egress by the fire service controls if available
- Inform occupants they are safe and rescuers are working to get them out (To help reduce confusion and make communication easier, have them silence the alarm if activated)
- As companies begin to get into position, the additional information from recon can now be used to formulate a rescue strategy

WHAT ARE THE RESCUE OPTIONS?

- <u>As stated previously, this section is not a comprehensive guide for elevator rescues. The order these steps are performed in will vary from one run to the next:</u>
    - Option One: Elevator Technician Arrival
    - Option Two: Elevator Fire Service Phase 1
    - Option Three: Elevator System Reset
    - Option Four: Hoistway Door Rescue
    - Option Five: Technical Rescue Through the Top of the Car

OPTION ONE: ELEVATOR TECHNICIAN ARRIVAL

- If victims are okay waiting (stuck less than an hour before the arrival of the technician, or the technician is already on scene), then waiting for the technician may be preferable. All major elevator manufacturers have elevator technicians on call 24/7, 365 days a year
- Remember to use building security and maintenance to contact the technician. This probably is not the first time this has happened; they usually have emergency contact numbers readily available

OPTION TWO: ELEVATOR FIRE SERVICE PHASE 1

- Also known as the Fire Department Emergency Recall system
- This method is often one of the first things crews attempt. Upon arrival, select the appropriate elevator and activate the recall system by completing the following steps:
    - Insert the elevator key and turn it to the "On" position (Three position switch: On, Off, Reset)
- Phase 1 recall has the following effects on the system:
    - Recalls all elevators to the Lobby or the appropriate floor
    - Cancels all call lights for service
    - Gives the fire department control over the elevators and accountability of the victims inside during an emergency. This allows firefighters to advance to Phase 2, which gives them complete control of the elevator car

OPTION THREE: ELEVATOR SYSTEM RESET

- To reset the elevator system itself, identify and turn off the appropriate shut-off in the mechanical room. The power must remain off for more than **thirty seconds**; after that, power the system back on. Wait at least two minutes for the computer system to reboot before pushing any buttons. Two attempts can be made if needed
- Sometimes resetting a faulty system can move a car when the computer is rebooting. This can possibly be counterproductive if the stuck car is already in line with a floor stop

UNDERSTANDING THE POWER SUPPLY

- Some elevators do not have separate power systems, but most elevators run off two separate power sources
- <u>The actual mechanics of the car run off 480 volts or 600 volts</u> (The photo below shows the elevator car as 120V 3PH. This equates to three hot legs, which total 480 volts)
- <u>The lights and ventilation fans inside the car are typically run off 120 volts</u>
- This is important to understand. When firefighters are sent to the mechanical room to reset the system, **reset the main system power (higher voltage)** while leaving the car lights and ventilation systems running (lower voltage)
- Being stuck in an elevator is naturally stressful. Firefighters not only have to rescue the occupants; they also have to try to keep people calm and comfortable by leaving the lights and fans on
- Firefighters should talk to the victim throughout the process and explain that the power is being reset, in case the lights do go out

OPTION FOUR: HOISTWAY DOOR RESCUE

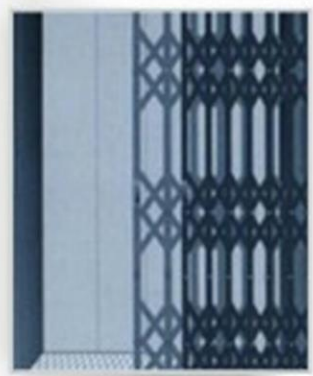
- Power should be shutoff during rescue, as this is the safest option
- Once the car is located, use the appropriate elevator hoistway door key to open the outer door
- If there is no keyhole present in the hoistway door on the floor where firefighters want to make access, an additional option is to go to the floor above and check that hoistway door for a keyhole. Firefighters could then use tools to reach down from the floor above and access the hoistway doors below

WHAT IS A HOISTWAY DOOR?

- Hoistway doors are the doors that can be seen from the lobby or hallway
- The cab door, or car door, is the actual door that travels with the car; it is behind the hoistway door
- Types of doors include single-slide, center opening, swing, and two-speed doors
- Doors are usually opened by a power unit located on top of the car. When an elevator is at or within the door lock zone, which ranges from a few inches to eighteen inches above or below the floor, the power unit opens and closes the cab door on demand


Swing Door


Capsule Lift


Collapsible Door


Telescopic Door

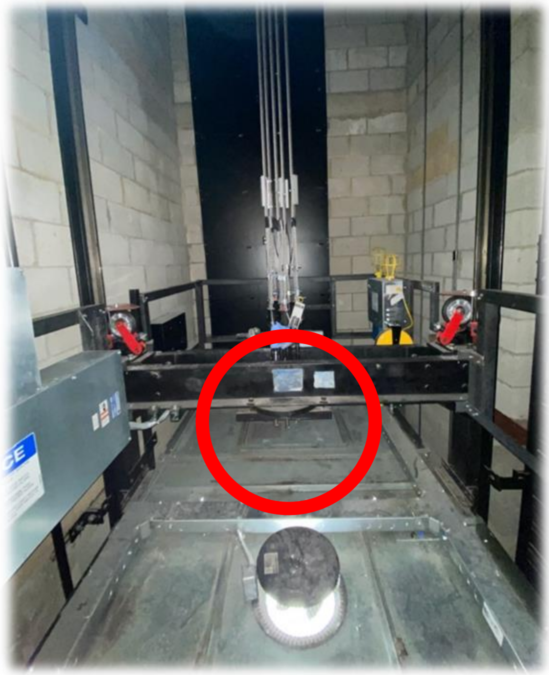

Imperforate Door


Auto Door

ACCESSING A HOISTWAY DOOR

- Drop keys can be used to access the manual release levers on the hoistway doors to expose the inner car door and access the trapped occupant
- The drop key is used to engage a rod or paddle, which deactivates the locking mechanism
- There are various styles of keys used throughout the department (Lunar/Half Moon, T, Single Drop, Double Drop, and Insulated Key)
- Typically, the most common keys used are the double drop key or single barrel drop key
- The series of photos below show a half moon key being used. First, the key is inserted at a downward angle and slowly lifted until the key catches the latch mechanism. Once the mechanism in the door is raised, the hoistway door can then be slid open by hand
- With the hoistway door opened, the crews can then access the locking mechanism of the elevator car door and remove the victims

OPTION FIVE: TECHNICAL RESCUE THROUGH THE TOP OF THE CAR



- Accessing the top hatch from above the car is A VERY DANGEROUS OPERATION AND SHALL ONLY BE A LAST RESORT!
- The decision will only be made by the B/C with consultation from Rescue Technicians
- Entry into the car will be by at least one rescue technician. Victims will be assisted using fall protection
- All cars affected shall have power controlled by fire department personnel
- Going through the top of the car is a Rescue Tech Operation only
- The red circles in the photos show the elevator hatches for a hydraulic elevator and a traction elevator

ADDITIONAL READING

Firefighters wishing to broaden their personal knowledge on elevator operations can seek out the following sources of information; they contain relevant information specific to elevators:

- ***Columbus Fire: Elevator Rescue TA Publication from 2014***
- ***Mike Dragonetti from Dragon Rescue Management***
- ***Elevator and Escalator Rescue*: *A Comprehensive Guide 2nd Edition*** by Theodore Lee Jarboe and John J. O'Donoghue
- ***Firefighting Operations in High Rise and Standpipe-Equipped Buildings*** by David M. McGrail
- ***Truck Company Operations 2nd Edition*** by John Mittendorf

Click here to view Captain Lash's Elevator School Video

Click here to view Lieutenant Kerns' Elevator Phase 1-2-3 Video

Click here to view Lieutenant Kerns' Hydraulic Elevator Service Runs Video

SECURING RESIDENTIAL WATER

OVERVIEW

- The ability to secure water is a key skill set needed to minimize potential property damage
- On working fires where the fire area involves utility closets, kitchens, or bathrooms, residential pipes can frequently be burned through. When this happens, water can continuously flow causing property damage to the home or adjoining units. Securing the water is a crucial step firefighters should not forget when assigned salvage on a fire scene
- Service runs are frequently dispatched for frozen/broken pipes, leaky faucets, leaks in plumbing, and a variety of other issues requiring a prompt response from crews
- Hydrants that are broken at the stem can require a ladder company to respond also; they carry the appropriate equipment to turn the hydrant off at the supply valve
- This section will demonstrate some techniques for securing water on single and multi-family residential structures, in addition to hydrant flowing responses. The severity of the run will dictate the best methods to use. This section is not all encompassing; it is simply an overview of some basic techniques that firefighters could use on scene

ISOLATING THE FIXTURE OR PIPE

- When called on a service run for a leaking fixture or pipe, the owner called the fire department because they did not know what else to do. Even if the problem seems easily resolved and better suited for a non-emergency response, firefighters are still here to perform a service for the customer
- It may be easier to turn the water off to the whole structure, but try to isolate the leaking pipe or fixture first. Doing so lets the owners still live in and function normally in the unit
- Fixtures will traditionally be controlled by quarter turn isolation valves. These can be found as levers or handles. Some older structures may use full turn valves, but those are becoming more outdated. However, issues with new plumbing are less common
- Since these valves are not exercised frequently, they tend to break or seize up when needed. In those cases, try to isolate the line that is leaking. For example, is it the hot water line under the sink? Try to find the hot water tank and isolate the hot water line leaving the tank. This would still let the owner have access to cold water for drinking, etc.

These quarter turn valves are notorious for failing and seizing

This inline valve’s handle is in line with the plumbing, meaning the water is on

Turn these handle valves clockwise to close, and counterclockwise to open

TURNING OFF THE MAIN WATER INSIDE THE HOME

- If unable to isolate the leaking pipe or fixture, the next step is to locate the main water shut off inside the home
- These are commonly found in one of two locations:
  - The first location is by the hot water heater; the main water line in and the water heater are often located near each other
  - The second location could be in the front of the home. To save on cost, plumbing is traditionally run into the side of the building closest to the source (water main at the street)
- Once the main line is located, find the control valve and turn off the flow of water. Quarter turn valves need to be turned so they are not in line with the plumbing. Hand wheel valves are traditionally clockwise to close, counterclockwise to open
- An inline valve that controls the main water into the home is shown above. Firefighters can tell it is the main line since the other end of the pipe goes out of the basement

SECURING THE WATER OUTSIDE THE STRUCTURE

- If the shut off cannot be located inside the home, the next step is to check outside the structure for the water box
- Water boxes are traditionally (not always) located in the front yard between the main water line coming into the home and the street. Loosen the bolt to remove the water box cover (photo on right), then use the water key to shut off the water
- It can still be beneficial to locate the main line into the house, even if it does not have a shut off valve on it. Doing so can help locate the water box in the front yard. The water line will typically run directly to the street, following the shortest distance to the main
- The curbs in front of the home can be checked to see if the water line has been marked. In newer communities, the letters S (Sewage), G (Gas), and W (Water) may be stamped into the curb identifying the location of the associated utility. If possible, locate the curb markings (W) and draw a straight line in between the W and the main water into the home to help locate the water box with the shut off inside

The “S” stamped in the curb shows the general location of the sewer line

The “W” stamped in the curb shows the general location of the water line

Locating the main water into the home and the W on the curb can help to locate the water box

SECURING THE WATER OUTSIDE THE STRUCTURE CONT.

- In some cases, the water meter box can also be found by the water box in the front yard. This is much more common on newer builds. Some residences have none, one, or both boxes. Shut off valves will traditionally be in a separate shut off box from the meter, with the meter being inside the home where the main water line comes in. However, it is not uncommon for the shut off valve to be located within the meter box as well as outside the home in newer developments. The photo on the right shows a shut off valve located inside the meter box. The same procedures for turning off the water apply
- If unable to locate the box, the water company can be called for assistance. The valves can be either quarter turn or full turn valves
- In some cases, a pair of channel locks or vice grips is all that is needed to reach in and turn off the valve. In other cases, the residential water key will be needed

OTHER RESIDENTIAL CONSIDERATIONS

- When upper units have a leak in apartment complexes, lower-level tenants may be the first to notice. Check the upper level and turn off the shutoff valve closest to the source
- If PVC or copper piping is broken or cracked and there is a delay in finding the shut off, use a water thief to reroute water. Salvage covers or water chutes can also be used
- For standing water on the upper level, taking the toilet off and squeegeeing water into the drain is an option. Stairwells may be another option to funnel water into
- Depending on the amount of water that is present, consider using the hydrant pump and utility hose to pump standing water to a more preferred location
- Hot water tanks can rust out over time, eventually leaking in a basement or even to a lower-level unit. Quarter turn shut off valves are located at the top of the tank where the water enters. The water thief adapter can be attached to the drain valve on the hot water tank to reroute the remaining water towards a desired area. The breaker for the hot water tank may need to be turned off to ensure any electrical hazards are mitigated

Water thief adapter and utility hose attached to the hot water tank drain

This utility hose is carried with the adapter in place

The utility hose can be connected directly to the hydrant pump

SPRINKLER HEADS

- This section will briefly discuss broken sprinkler heads, since many multi-family residences have sprinkler systems in place
- Sprinkler heads are a common source of water issues
- For a broken sprinkler head, consider bringing an 8’ pike pole and a short section of 2.5” hose
- The hose can be used to cover the sprinkler head (supported by a pike pole) and route the water elsewhere to minimize further property damage while crews are finding the water shut off valve
- Note—once the supporting riser is shut off, open the system drain valve to drain all the water from that isolated system

HYDRANT FLOWING RESPONSES

- A hydrant stem can snap while the hydrant is being opened or closed. This can occur on fires, training, or routine hydrant checks. This leaves the hydrant flowing, with the only shut off option being the supply valve underground. This valve should be located underneath a metal cover in front of the hydrant (between the hydrant and main)
- Crews can remove the cover and use the large water key to turn off the water to the hydrant. Place the large square head of the key over the operating nut inside the hole and turn it until the flow of water is stopped. Most of these valves will be turn valves (clockwise to close, counterclockwise to open). However, according to the water department there are some occasions where inline quarter turn valves are used
- The small residential water key can fit over the top of the bolt that holds the square operating nut onto the valve. **DO NOT USE THE SMALL WATER KEY FOR THIS**. It could accidently remove the metal bolt that holds the operating nut onto the assembly
- Every broken hydrant should be documented in water web
- The “small” water/gas key (bottom left photo) with the notch in it can be used on both residential water and gas shut off boxes. If flipped upside down, the top of the key can be used on the bolts on the curb boxes to unlock the cover. The “large” water key with the square head (middle photo) can be used on control valves in the main system
- Bottom right photo shows crews using the large water key to turn a broken hydrant off at the valve. A Halligan was used to remove the cap

SECURING COMMERCIAL WATER

OVERVIEW

Commercial water systems may be something firefighters encounter frequently or only on rare occasions, depending on their running district. Regardless, every district has some form of commercial suppression system firefighters will encounter on runs. These systems can sometimes be challenging due to the size of these structures and the various types of suppression systems within them. However, the thought process for securing commercial water is generally the same as residential structures, with some additional points to consider for high-rise and big box style buildings. This section of the manual will discuss some considerations when dealing with a commercial water/suppression system; however, this section is not intended to cover every possible scenario or system crews may encounter.

DISPATCH

Crews could be dispatched on the report of a Water Flow Alarm, Fire Alarm, or possibly a service call. Water Flow Alarms indicate that a fire suppression system has detected water flowing through the riser that it is attached to. A signal is then sent to the Fire Alarm Control Unit, alerting either the alarm company or directly alerting a 911 response. The reason for these alarms can be numerous:

- Accidental sprinkler head damage by occupant or vandalism
- Frozen pipes bursting
- Pressure surge causing false activation
- Corrosion leading to a broken pipe
- Alarm is accurate and there is a fire

ARRIVAL/ACCESS

Upon arrival, crews will generally choose the street or address side of the structure. There are various scenarios that could be encountered at this point as far as gaining access:

- Is the building occupied? (Depends on the time of day if it is a business). Is this a vacant structure? Some buildings will have security personnel meet crews in the evening, or they may have a contact number for a “Keyholder” that can meet crews on scene to provide entry to the building
    - The FAO will usually notify companies if there is a keyholder on the way
- If there are no obvious signs of a working incident (Such as smoke/fire showing or water flowing from the building), then crews may opt to wait for the keyholder before accessing the building
    - Crews may determine that this is more than a false alarm and attempt to gain access prior to the keyholder’s arrival to further investigate/mitigate the problem
- Many buildings have Knox-Box access, allowing crews to gain entry upon arrival

MAINTENANCE/SECURITY PERSONNEL

Crews arriving on scene to many commercial or high-rise occupancies may meet maintenance or security personnel. These workers may be hired for this specific occupancy or multiple buildings. They can generally provide access to areas crews need to enter and give them more information on what caused the alarm (false activation, sprinkler head knocked off, smoke in the building).

- In addition, these workers may be extremely familiar with the building's layout and how its systems operate
- Crews may encounter other workers who are unfamiliar with the building's systems and may be unable to provide firefighters with much guidance on locating specific areas (such as an alarm panel, riser room, etc.)

If crews do not meet anyone upon their initial arrival to the scene, they can progress inside to investigate further, wait on a keyholder as mentioned previously (situation dependent), or look for other external indicators.

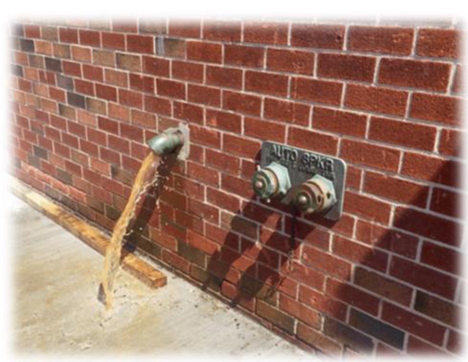
WATER GONGS

Water Gongs are meant to act as an external notification alarm for civilians in the area. These are not found on every building firefighters may encounter, but they can be helpful to immediately alert responding companies arriving on scene. These devices are linked directly to the riser system and will activate when water is flowing through the suppression system riser. If crews arrive and hear that one of these devices has activated, that should increase the crew's suspicion that this is likely not a false alarm.

- Many alarms are mechanical and will only operate when water is actually flowing through the riser system (Indicating a sprinkler is flowing or a burst pipe)
- Other Water Gongs may be electrical and are activated via a pressure switch (riser system may have had a pressure fluctuation, but water might not actually be flowing)

Water Gongs are often strategically located near other important fire system components to help draw attention to them for the responding companies.

DRAIN ELBOW



Crews may also see water coming from a drain elbow located below the water gong. If water is flowing from this drain, then firefighters know water is flowing somewhere in the riser system. If there is no active water flow but the area around the drain is wet, this is mostly likely a false activation due to a pressure surge.

- As mentioned previously, an electronic gong may still be activated due to pressure in the riser, not due to active water flow.

FIRE ALARM PANEL

Near the main entrance, there will often be an annunciator panel linked to the main Fire Alarm Control Panel. These can help guide crews to the location of the problem or relatively close to it (Panel to the right shows 3rd floor water flow alarm). Some buildings may be "zoned." High rise buildings may give a room number on the panel. These panels are often not made with the fire department in mind and may not always help guide crews unfamiliar with the building.

MULTI-STORY

When investigating the cause of an alarm in high-rise buildings, crews should follow CFD High-Rise SOPs regarding progressing to floors above the ground level. If the cause is a burst sprinkler head or piping, the flow of water will need to be stopped to prevent further damage to the structure.

PLUGGING THE SPRINKLER HEAD

Crews may opt to use one of the tools from a sprinkler kit to stop the flow of water from the sprinkler. Two wedges from the standpipe bag can also be effective to stop a broken sprinkler head, although this may be difficult to perform with a pressurized head flowing. Not to mention, the member performing this task will be less than dry after completing the task.

ISOLATION/CONTROL VALVE

Crews can attempt to trace water back to the source to isolate the leak, similar to residential water supply systems. Sprinkler systems may have a separate water supply, or they may be supplied by the same riser as the standpipe connection. Firefighters can head to the stairwells to look for a control valve or isolation valve. These control/isolation valves allow firefighters to isolate this branch of the sprinkler system to stop water from flowing, while still keeping the rest of the sprinkler system operational. Turning the Control Valve Handle (red circle in the photo on the right) until the butterfly valve indicator is perpendicular to the flow of water will shut off water flow into the sprinklers on this level.

Once the water supply to the sprinklers is shut off, the water remaining within the piping on that floor will continue to drain from the piping. If equipped with a pressure gauge, crews should see pressure starting to drop in the system. If the system is equipped with a drain valve, opening the drain can speed up the removal of water from the system and divert water from the opening in the piping. With less pressure now coming from the sprinkler head, it may be easier to secure the water coming from it.

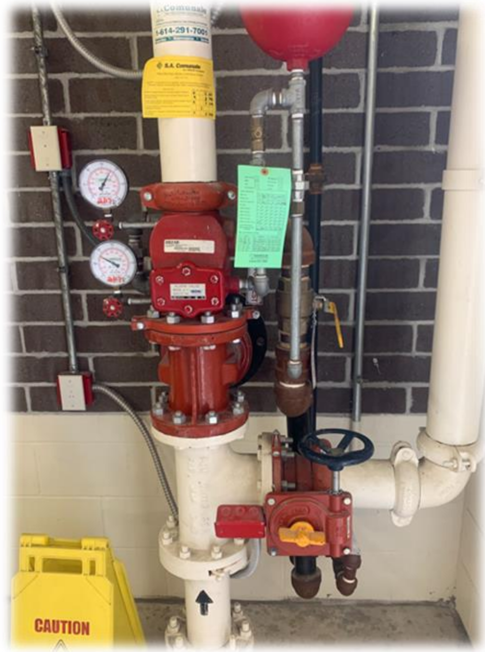
OTHER CONSIDERATIONS

Whether or not there is a control valve for the sprinklers can vary from building to building. Some control valves may be located in only one stairwell. If the first stairwell that firefighters inspect does not have a control valve, it may be in the opposite stairwell. The photo on the immediate right shows a standpipe in the stairwell opposite of the one in the photo above. Note the lack of a control valve. The photo on the far right shows how the height of the control valve (or sprinkler) may dictate decision making. Firefighters may need a step ladder to access these valves.

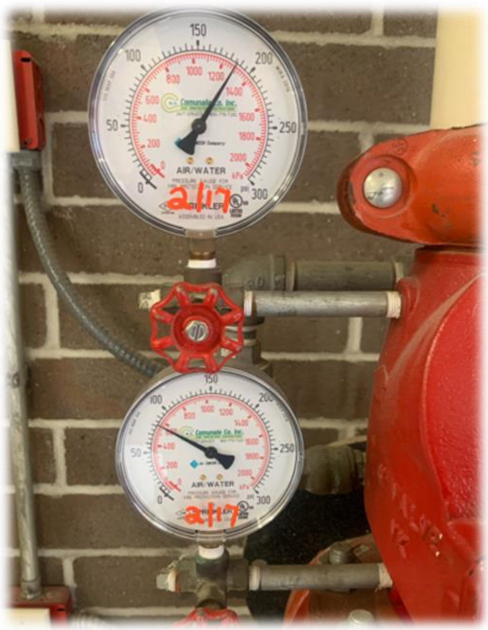
Larger buildings may be zoned and have valves that only control a portion/zone of sprinklers, requiring firefighters to find the correct corresponding control valve. Some control valves may be hidden, such as above drop ceiling panels. The photos on the right are from the YWCA building; they have even marked their tiles to help firefighters locate them.

If plugging the sprinkler or closing the control valves are not options, firefighters will need to find the riser room. As mentioned previously, maintenance/building engineers can be extremely helpful for locating system components like the Fire Alarm Control Panel and the riser room. External components like the FDC connection are often near the riser room location.

RISER CONTROL VALVE



Once the riser room is located, crews will have to investigate to determine which valve control will shut down flow to the sprinkler head. If the building is equipped with a fire pump and it is running, that can also be shut down. Doing so slows the flow of water and may assist with closing valves. Pressure from the leaking valve or sprinkler head should slow down once the correct valve is closed (crews may decide to use radios to communicate between the crew in the riser room and the crew near the leak). There should also be some type of drain valve on or near the riser to expedite water removal from the piping. An open sprinkler on the fourth floor would still have to drain all the water from the floors above; therefore, the leak would still need to be controlled if possible.



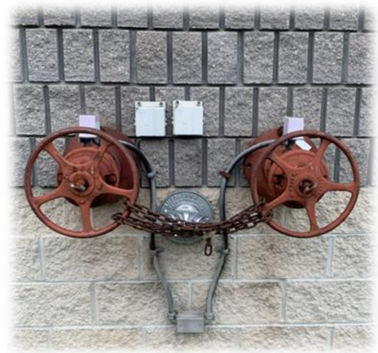
This system shown in the above right photo has a combination wet/dry riser on the left and a wet riser on the right side. If unsure which riser to turn off, firefighters may be able to look at the dry riser's gauges to see if the system has been charged or not. The photo to the right shows the upper gauge (air pressure) around 185psi and the lower gauge (water pressure) around 80psi. This is normal for the system; it takes more air pressure to hold back the water pressure to keep water from entering the riser. If these gauges were equal pressures, that would indicate the system has been pressurized due to water moving into the riser. This could also be the riser that is giving a false water flow alarm due to a pressure surge allowing water into the riser.

REPLACING THE SPRINKLER HEAD

Many riser rooms might also have replacement sprinkler heads located within the room in a box like the one on the right. These boxes may also have a wrench specifically designed for removal and installation of a new head. Crews can remove the broken head and install the replacement head. With this new head installed, the riser can be reopened to ensure the occupancy is not without protection until a licensed technician can inspect the system.

WALL/POST INDICATOR VALVES

Another option for shutting down water supply to the suppression system is using wall/post indicator valves. These are located on the exterior of the building and are often near other components like the FDC. There can be several of these on large commercial buildings, with each corresponding to a specific zone/area within the building. These valves are frequently chained shut to maintain system integrity; crews may need bolt cutters or a circular saw to remove the chain.



Post Indicator Valve

Post indicators will generally have a wrench padlocked to them to be used for opening and closing the valve. Some may not have a wrench attached to them, and crews will need to use a wrench from the apparatus in order to close the valve.

Many of the nuts on the post indicator valves will be too large for CFD hydrant wrenches. A 5-sided hydrant wrench will be needed to operate these valves.

The view window will indicate whether the valve is in the **OPEN** or **SHUT** position. Closing the valve may take 20-30 turns to accomplish.

If a fire pump were running, crews should shut the fire pump down prior to closing these valves. Otherwise, this could lead to damaging the fire pump.

OTHER CONSIDERATIONS

Anytime a sprinkler has activated or a water flow alarm is indicated as the cause for the alarm, it should be investigated prior to shutting down water supply to the system. Prematurely shutting down the sprinkler system could cause a fire that was nearly contained (not extinguished) to grow, leading to more damage than the water from the sprinkler system. Once it is determined that the fire is out, crews can proceed with stopping the flow of water.

Cold Smoke

Firefighters may encounter what is sometimes referred to as "cold/wet smoke" conditions. This is encountered when a sprinkler has activated due to fire and has cooled the smoke, taking away much of its velocity and heat. This can give crews a false sense of security; it should always be remembered that smoke that is filling a large compartment could indicate a large fire deeper within. Smoke conditions can change as crews get closer to the source, causing firefighters to be disoriented. Cold smoke is still considered an IDLH environment. Crews should consider bringing ropes when attempting to find the source, depending on the situation. The fire in the photos on the right was from a 20' x 30' pile of burning cardboard that was contained by sprinklers, but it was still burning in areas the sprinkler could not reach.

Securing water is an important part of protecting property and minimizing damage. A recent study by the NFPA estimated there is roughly $1,000 in damage for every minute that a sprinkler head is left open. Once it is determined that it is safe to shut off the water supply, crews should proceed with salvage and overhaul functions to remove water from the structure.

ELECTRICAL EMERGENCIES

OVERVIEW

- Crews are often called out for a variety of service calls involving electrical issues. These can range from odor investigations, sparking outlets, light hazes, loss of electrical power, etc.
- Although CFD has specific run cards for certain types of electrical emergencies, it is not uncommon for firefighters to find themselves in one of the situations below after being dispatched on a service run. For example, firefighters could be dispatched on a fire service run, and the remarks on the run card say, “Lights keep flickering.” Upon arrival, firefighters find a car that has struck a power line that is causing the influx in power. This is one example of a service run that ends up being more than a service run, but firefighters must still mitigate the emergency
- This section is not meant to replace CFD SOP 02-03-17. It is simply designed to provide some information about various common types of electrical emergencies that may be encountered on the street

SMOKING OUTLETS AND BREAKER PANELS

INVESTIGATION CALLS

- A common fire service run firefighters may be dispatched on is an electrical outlet that was smoking or sparking
- While these are frequent events in the city that are often downplayed, they should be investigated quickly and immediately for possible fire extension
- Upon arrival, ask the occupant what happened. Did they see fire? Smoke? Sparks? Where was it, and what were they doing when it began?
- While members of the crew attempt to locate the breaker panel, the other members should investigate the affected area using the TIC
    - Crews should check the area for any extension into the surrounding walls
    - If needed, the electrical cover can be removed to further inspect the box
    - The TIC can also be used to see if the appliance, fixture, or wires in the wall are overheated. <u>Do not be afraid to open up the drywall around the suspected area!</u>
- The crew members checking the panel should look for/attempt the following:
    - If no breakers have tripped in the panel, attempt to isolate the associated breaker. If it is up to code, the panel should be labeled for what it controls; however, these labels are often missing, wrong, or poorly worded
    - Some ladders carry a breaker isolation tool that can be used to isolate the correct breaker
    - If unable to isolate the breaker and a hazard exists, kill the power using the whole house breaker
- Tell the occupant to leave the power or breaker off until they can have it evaluated by a professional electrician

Pictured to the left are a few electrical tools found on some ladder companies in Columbus. These tools, which include a voltage meter and circuit breaker finder, can be very useful when attempting to isolate an electrical issue. Voltage meters can be used to determine if power is still on to a device. The photo on the right shows a voltage meter being used. Typically, red means the power is on to the device; green means the power is off

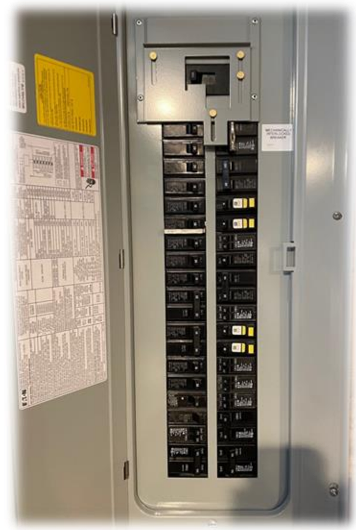
Circuit breaker finders can be used to find the associated breaker on a panel. The transmitter gets plugged into an outlet as shown in the photo on the left. The light will illuminate indicating that the transmitter has power

With the transmitter plugged in, the receiver tool can then be used on the breaker panel as shown in the photo on the right. Drag the receiver over the breakers. Red means it is **not** the associated breaker

When the receiver is over the appropriate breaker, the light will illuminate green indicating it is the associated breaker as shown in the photo on the left

SECURING THE POWER

- Firefighters assigned to kill the power to a structure on a service run, electrical emergency, working fire, or other emergency have several options. Usually, the first move is to try to locate the main breaker panels and use the main breaker to kill the power



    - Turning off the main breaker at a working fire will leave all the other breakers in place the way they were before crews arrived. This can be very helpful for the arson investigators. The photo on the right shows a main house panel with unlabeled breakers. The top breaker is the main whole house breaker
    - If for some reason firefighters do decide to use the individual line breakers in the panel at a working fire, they should take a mental note of how the breakers were found and relay that information to the arson investigators
- Larger homes and business can have subpanels. Firefighters probably will not be able to tell right away if they have located a subpanel or a main panel

    - The most tell-tale sign that firefighters located a subpanel is that the power may still be on after turning off the main breaker. The photo on the right shows a subpanel that was added to the home's workshop area. Turning these breakers off will not kill the power to the rest of the home controlled by the main panel
    - This should make firefighters suspect that they have located a subpanel. Subpanels are frequently found in home additions or workspaces, and main panels will most likely be located wherever the main power source comes into the building
- Some structures have an exterior electrical disconnect by the meter. Multi-family residences may have a disconnect by each meter (along with a main disconnect for the entire building). The photo to the right shows multiple meters with an exterior disconnect for each under the black covers

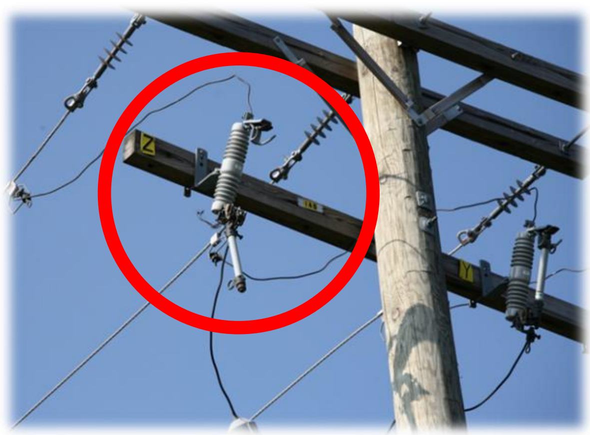
- Some structures have a Smart Meter that can be shut off remotely by the electric company. Refer to the Remote Power Shut-Off Options section of this manual for more information on those types of meters
- Cutting drip loops is an option as a last resort at 1 or 2 family residences when all other attempts to control the power have failed. Refer to the Cutting Drip Loops section of this manual for more information on that technique

WIRES DOWN AND POLE FIRES

WIRES DOWN

- Wires down should always be treated with caution
- If possible, attempt to identify which side of the wires down is the hot side
- Look both directions to see which side of the line the power is live on
    - Are the streetlights on? Is one side of the wires on the ground actively arcing?
    - Are the wires down in the back yard? If the wires are connected to the pole, that will be the hot side of the incident
    - Are the fusible links on the pole tripped? These could help firefighters identify if the lines that are down are live wires that pose a significant risk
- <u>Wires down should always be treated as live wires, regardless of any of the information above</u>
- Are there wires down on top of a vehicle or other object presenting a life hazard? Follow SOP 02-03-17

This truck drove through low wires and pulled over the power pole. The first question firefighters need to ask is where is the driver? Are there people in the truck?



This photo shows a tripped fusible link on the power line. The highlighted circle shows the link tripped in the open position. The fusible link on the right side of the photo shows a closed link that is not tripped

POLE FIRES

- Can be difficult because the decision exists of whether or not crews should apply water
- In the majority of cases, water should never be applied directly to a pole fire. Besides the obvious associated electrocution risk, the hazardous oils inside the transformer present additional risk to crews
- Crews should request the electric company to the scene to secure the power before extinguishing appropriately, if needed
- For pole fires, the focus is on securing the scene and watching possible exposure concerns

WHAT ACTIONS SHOULD FIREFIGHTERS TAKE?

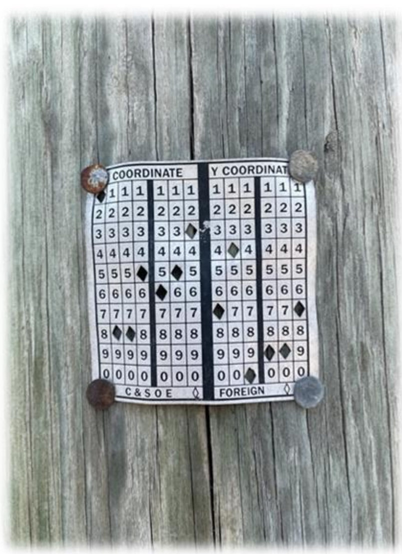
- The very first thing firefighters should do is approach with caution, especially at night when visibility is limited!
    - It is not uncommon for the initial dispatch address to not be the location of the emergency. It could be next to, behind, or across from the address. Drivers should approach the scene slowly!
- Once the hazard is located, secure the area and tape off any hazard areas as needed
- Firefighters must determine if there is an immediate hazard present or not. This can be a tricky decision; do not be afraid to call and ask for another apparatus or BC for help
- If no hazard is present, tape off the area and relay appropriate information such as pole numbers and locations to the FAO. Clear the run after relaying the appropriate information (Refer to the Identifying the Pole section on the next page)
- If there is an immediate hazard present, firefighters obviously cannot leave the scene
    - Is there a fire threat? If so, firefighters should maintain their distance while keeping a close eye on ignition/extension. Use the TIC on the inside of homes if needed. Common hazards may be tree lines, fences, sheds, and garages
    - Is there a civilian threat present? Is the pole fire above a major roadway, intersection, or sidewalk? Are there wires down?
    - If so, secure the area by whatever means necessary. This could include blocking lanes of traffic from multiple directions. Do not be afraid to request and use CPD to assist with traffic control
- Review SOP 02-03-17 for more details about electrical emergencies

This photo shows wires down that resulted in a car fire. The wires are still live and arcing on the ground. Not only is there an obvious electrocution hazard present, there is also an exposure concern due to the fire

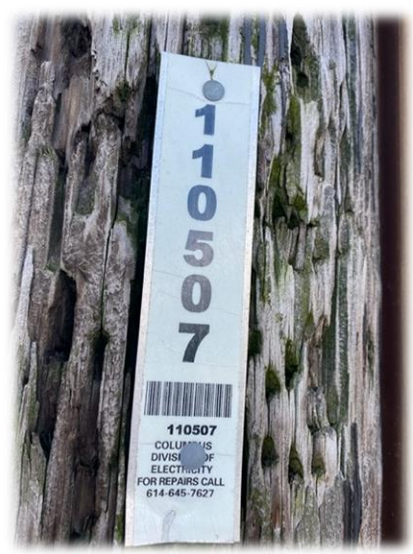
IDENTIFYING THE POLES

- One of the key components to handling pole fires and wires down emergencies is the ability to quickly and accurately identify which poles are involved in the incident
- The three main service providers in the general Columbus area are as follows:
    - AEP (American Electric Power)
    - Columbus Municipal Power
    - South Central Power Company
- It is common that electrical companies will share poles, even though each individual company may not be listed on the pole
- When new poles are installed, they will rarely have ID name tags on them. This is something that will vary from one district to another

Some poles will have the company tag attached to the pole as shown in the photo on the left. Other poles will not have company identification tags present. It can depend on the age of the pole. This pole on the right does not have an AEP metal identification tag like the left photo; however, above the pole ID numbers there is an AEP logo present



Some poles will not have traditional pole number tags, but will have X and Y coordinate tags as shown in the photo on the left. These tags can be read off to the FAO just like a pole number tag. The photo on the right shows a Columbus Municipal Power pole number tag as indicated at the bottom of the tag ID



IDENTIFYING THE POLES CONT.

- It is important to get the electric company started by relaying a description of the emergency and the pole number to the FAO
    - Even if unable to find a company ID name on the pole, pass on to the electric company the location information; they can look up which company is responsible
- If unable to get close to the pole, at least give a geographic description
    - For example, "Columbus Fire from E-15, we are on the southeast corner of Livingston and Fairwood; the first pole on the corner is on fire"
    - Another option is to go to an adjacent pole and relay its number to the FAO; tell them that it is the pole to the north, south, east, or west
- If a streetlight is present on the pole, one of the companies that has power to the pole is usually Columbus Municipal Power

IDENTIFYING UNDERGROUND UTILITY MARKERS

On service runs and emergency scenes, it is not uncommon to have to identify different types of utilities on scene. The chart on the left shows the color-coded utility marking system used in the United States. This chart from the US Survey Corporation reviews the common utilities and their associated color markings for underground services.

CUTTING DRIP LOOPS

ABOVE GROUND SERVICE DROPS

This section will review the basics of a residential service drop, starting at the pole and transformer and going to the house service drop. At the pole, there are two 120-volt coated wires coming from the transformer and one bare aluminum wire connected to the ground/neutral of the distribution line. This bare aluminum wire provides structural support for the entire service drop

The bottom end of the service mast connects to the meter. From the meter, the wires will go directly to the breaker box unless an exterior electrical disconnect is present. If an exterior disconnect is present, it would be on the opposite side of the meter from the wires that come from the transformer (photo on the right). Turning this disconnect off should isolate power from entering the structure. The breaker box inside the structure should also have a main breaker to shut off power

When the service drop (wires) reaches the residence, they connect to the service mast at the weather head. Some weather heads are just screwed to the siding on some residences, while others may drop through the roof (photo on the left). The two coated wires coming from the transformer connect to the wires that are coming out of the weather head, and the bare aluminum ground/neutral is attached to the service mast or to the siding

ELECTRICAL EQUIPMENT REQUIRED

Depending on the method chosen to shut power off to a residence, some electrical equipment will be needed. Some of the options for shutting off power to a residence are shown below:

1) Shut off the outside disconnect (if available)
2) Shut off the main breaker in the breaker box
3) Smart Meter with remote power shutoff capability
4) Cut the drip loops

Options 1, 2, and 3 above can be used for overhead service and for underground service, without requiring any special tools. Option 4 is only used for overhead service. According to SOP 02-03-17, cutting drip loops is only to be done at 1 and 2 family residential structures due to the higher voltage present at multi-family and commercial structures. Cutting drip loops is performed if other attempts at controlling the power have failed.

When cutting drip loops, some specialized equipment will be needed. This equipment is carried on ladders and rescues. Firefighters must always wear a helmet, eye protection, turnout coat, and turnout pants when assigned to cut drip loops. Additional required personal protective equipment and tools necessary for cutting drip loops are shown below:

- Fiberglass hot stick cutters (Rated at 10,000 volts per linear foot for five minutes)
    - Should be stored in canvas bag
    - Should be checked every Monday for damage and should be cleaned and waxed if needed
    - Should be tested every other year, scheduled by Tools and Equipment
- Rubber dielectric gloves and leather outer protective gloves
    - Should be stored in a sealed bag
    - Tested every six months by Tools and Equipment
- TAC Sticks
    - Carried by Engines, Ladders, and Rescues
- A ground ladder may also be needed

CUTTING THE DRIP LOOPS

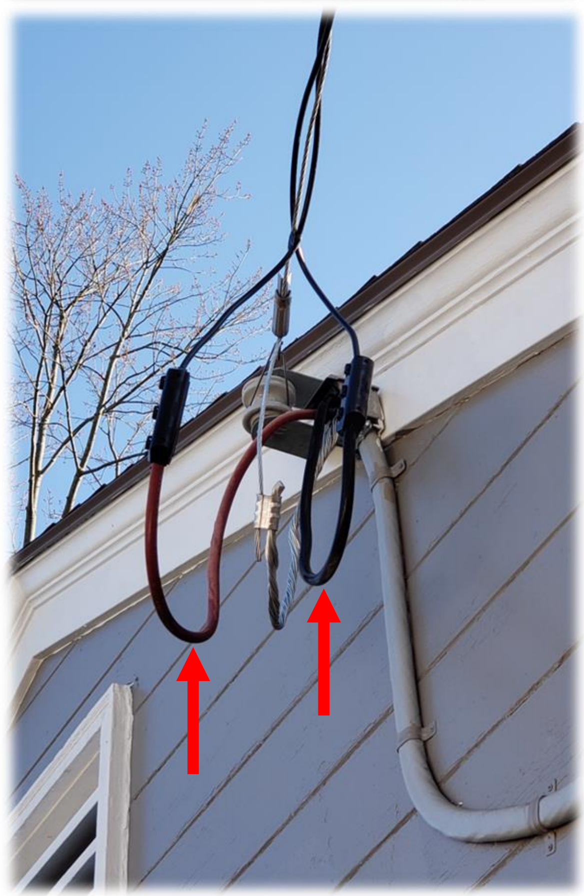
Once the firefighter has donned all the required gear (helmet, eye protection, turnout coat, turnout pants, rubber dielectric gloves, and leather outer protective gloves), they can prepare to cut the drip loops.

Start by locating the overhead service line that is supplying the structure. It should run into a weather head and/or mast attached to the side of the structure. Examples of these attachment points are shown in the photos on the right. At either of these attachment points (weather head or mast), the firefighter should see three wires coming from the pole and transformer—two coated 120-volt wires and a bare aluminum wire.

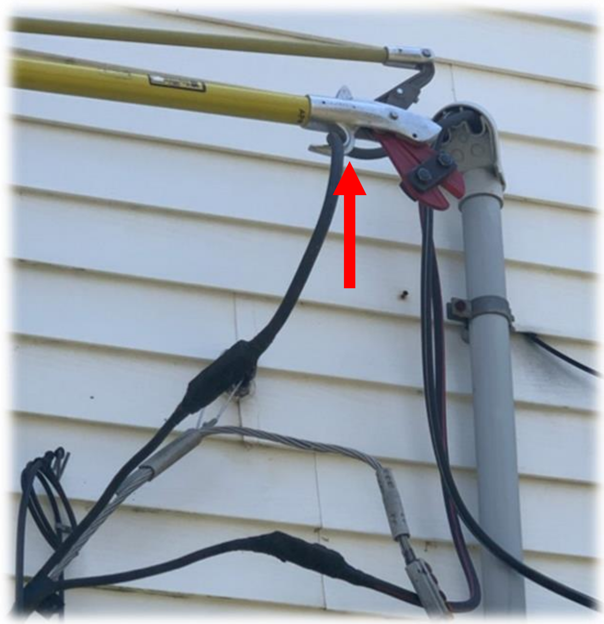
At the weather head, locate the two insulated 120-volt drip loops that are hanging down (marked by red arrows in each photo). The drip loops may both be black, or possibly have one red and one black, as shown in the bottom right photo. These are the two wires that need to be cut.

If the drip loops are close to each other or close to the ground/neutral, the firefighter will need to separate the wires using the hook on the back side of the cutters. Doing so should help keep the cutters from contacting the other wires as the cut is being completed. **The firefighter cutting the drip loops should try to work from a location where the wires would not contact the firefighter or the ladder if the wires were to fall from the house.**

Identify the bare aluminum wire that is attached to the structure and to the pole to support the two 120-volt wires. **DO NOT CUT THE BARE ALUMINUM SUPPORT WIRE BETWEEN THE ANCHOR POINT AND THE TRANSFORMER.** Doing so can allow all the wires to drop to the ground. This would create an electrical hazard on the fire scene (wires down).



With the proper PPE on, the wires identified correctly, and the wires separated to keep the cutters from contacting multiple wires, the firefighter can cut the first wire (below left photo). Open the cutter jaws and place them over the wire. Make sure the cutters are not in contact with anything; the head of the cutter should not be contacting any type of metal. Pull the lever to make the cut. *Note: the photos on this page came from a training opportunity at an acquired structure. The drip loops had already been cut back at the pole by the electric company, which made so the wires are not strung tight coming into the weather head.*



After cutting the wire, use the hook (top right photo) or the cutter jaws to move the end of the wire that was just cut away from the other cut end of the wire to prevent contact. Repeat this procedure on the second 120-volt insulated wire. Stagger the second cut away from the first cut to keep the two wires from contacting each other. **REMEMBER NOT TO CUT THE BARE SUPPORT WIRE.**

Once the drip loops have been cut and electrical supply to the structure has been eliminated, firefighters should clear the area and monitor for any changes that may allow the wires to drop to the ground and create another hazard. Firefighters should also consider secondary power sources, as shown on the next page.

OTHER POWER SOURCE CONSIDERATIONS

Ground Transformers

Many structures are supplied by underground wires going to a ground transformer. Firefighters should not open these transformers because there is no way to disconnect the power inside without special tools. Call for the electric company on emergency if there is a need to shut off a ground transformer. Firefighters can also look for outside disconnects on the structure or use the breaker box to disconnect power

Backup Generators

After cutting the power to a residence, firefighters need to check for a backup generator that could begin to supply power to the house when it recognizes the normal power supply has been shut off. Firefighters may find an outside disconnect or switch to shut off power for the generator. There may also be a separate breaker box close to the original breaker box that can be shut off. The fuel supply to the generator could also be turned off

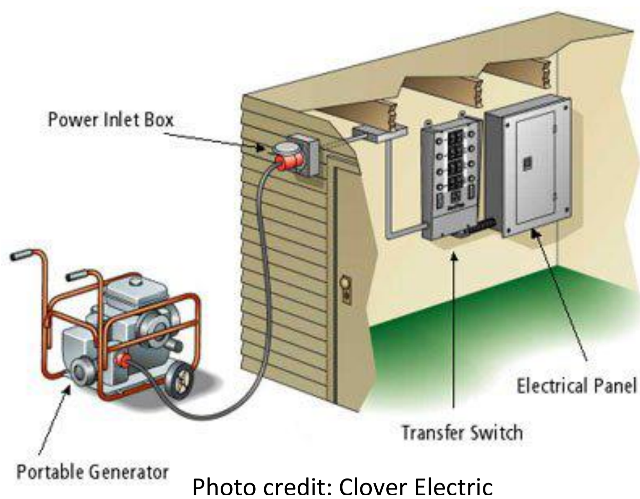


Photo credit: Clover Electric

Solar Power

Solar panels can still put out power even on bright moon-lit nights, and even if they have been damaged from fire or hail. To shut solar power off to the interior of the structure, there is an outside disconnect as shown in the photo to the left. The panels will still be putting out power; any operations near the panels should be done with caution. Other things to consider are the extra weight that is added to the roof from the solar panels, and any issues that storage batteries may pose

REMOTE POWER SHUT-OFF OPTIONS

INTRODUCTION

- Since 2015, AEP has been testing and installing Smart Meters in the Central Ohio Region. These meters will continue to become more common as older meters are updated
- Smart meters allow the electric company to remotely monitor, read, and control the power to the end users
- This section will discuss how to identify a smart meter, and how to read the meters to determine if power to the residence is on or off
- <u>Use of remote power shut-offs should primarily be considered for single-phase electrical systems, which are mostly found in residential settings</u>

SMART METERS

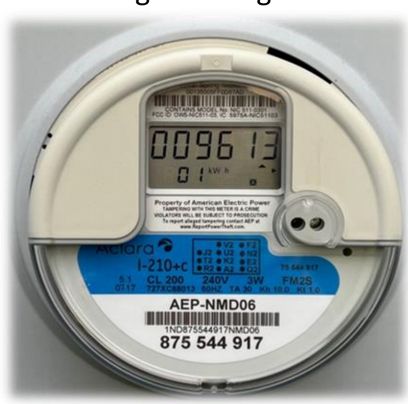
- Smart Meters are identified by a blue label on the electrical meter
- Crews should inform Command if a smart/remote meter is found. Command can then notify the FAO; the FAO will contact the power company to turn off the power to the structure remotely
- If power is turned off remotely, it will be shut down at the meter. This means that the wires between the power pole and the meter will still be live. The power will only be off from the meter into the home
- <u>All overhead wires should still be treated as hazards</u>

IS THE METER ON OR OFF?

- Just read the smart meter to determine whether it is actively supplying power to the residence or not
- The meter will either be <u>Closed</u> or <u>Open</u>

<u>Meter Reads Closed</u>

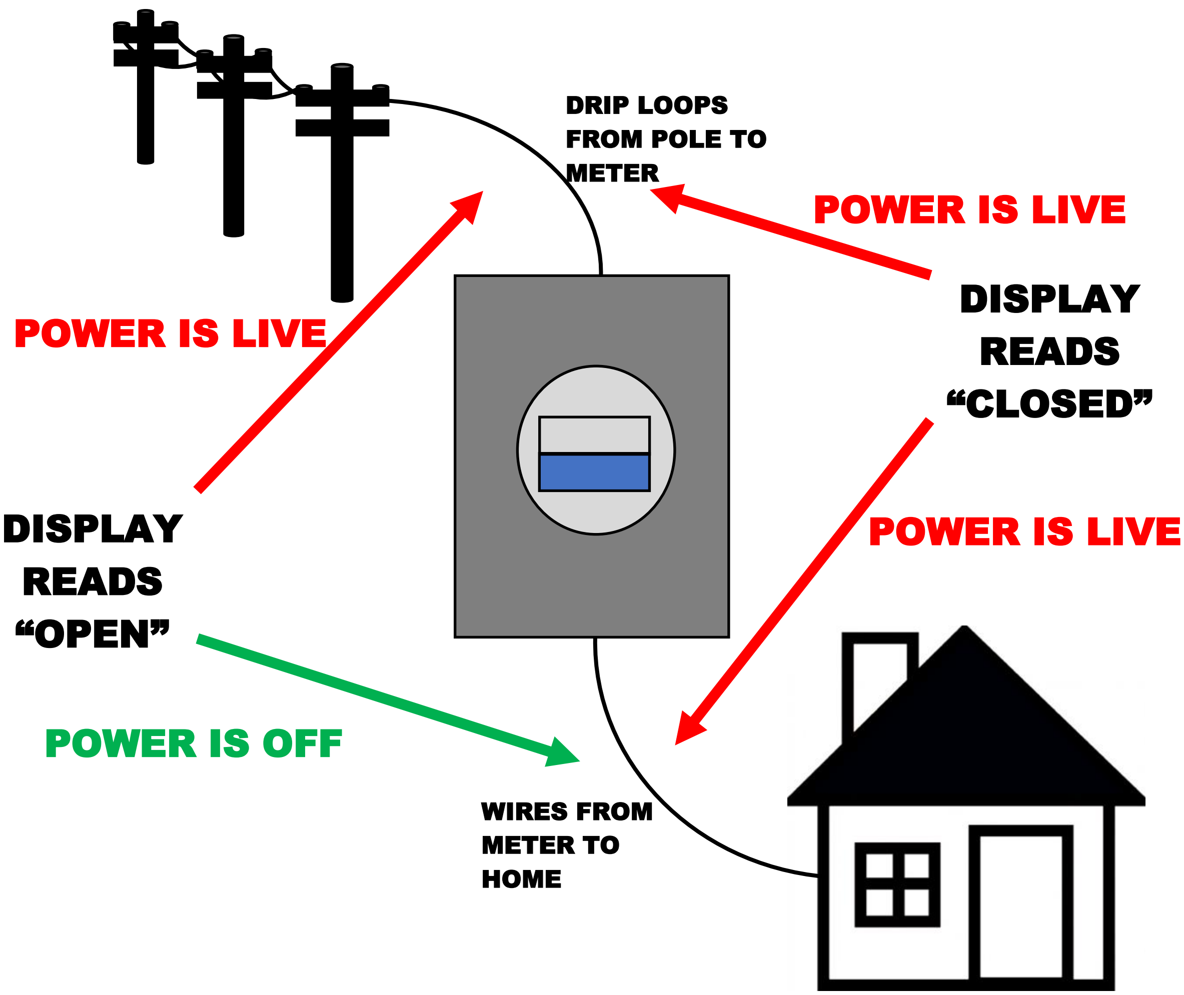
- The circuit is closed, and power is **ON** from the meter into the structure
  - With the circuit closed and actively drawing power, the display will cycle between showing CLOSED and showing the electrical usage reading from the home



Meter Reads Open

- The circuit is open, and power is **OFF** from the meter into the structure
  - Once the power is shut off to the home, the display will cycle and display OPEN

OPEN VS CLOSED: WHAT STILL HAS POWER?



WHY IS THIS PRIMARILY A RESIDENTIAL CONSIDERATION?

- There are numerous variables pertaining to electrical supply systems into structures. Remote meter shut-offs are a great option to consider on single and multi-family residential structures. However, there are numerous factors to consider when determining if remote power shut-offs are a reliable way to isolate the power in commercial structures. If there are any questions, the electric company should be consulted
- On single-phase electrical systems like those found in residential settings, the flow of electricity traditionally moves from the power source, through the meter, and into the house as shown on the previous page

- Commercial structures or structures that have larger electrical demands commonly function on multi-phase electrical systems
- In these systems, power <u>may</u> not run through the meter. It could instead travel through what is called a current transformer cabinet (CT cabinet), then run directly into the structure
- The associated meter is then tied into the system with a "lead wire" that allows the meter to read the flow of electricity through the CT cabinet for electric company billing purposes. This electric meter could be a smart meter with remote shut-off capability
- In these set ups, the smart meter can still be "opened" or "closed" remotely. This could lead firefighters to believe that the power has been secured. However, power is still running through the CT cabinet and into the structure, since the smart meter does not actually control the flow of power in this case
- However, this does not apply to all commercial power supplies. In some instances, commercial structures function off a single-phase system where power can be traced from the power lines to the drip loops, into the meter, and into the structure

Regardless of the smart meter display, power can still be live. The electric meter is only used to read the electrical usage. When attempting to secure the power from outside the structure, the electrical company must be called to shut it off inside the CT Cabinet.