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An open Nozzle addresses both Life Safety and Fire Attack!

¨Fire control goes hand in hand with life safety¨

-Andrew Fredericks

Rescue is an objective not a task! Meaning… it doesn't matter how rescue gets done, only that it gets done. It can be said that any action which improves the probability of survival for an unprotected victim is considered a rescue effort. An open Nozzle does just that.

SMOKE KILLS MORE PEOPLE THAN HEAT!

An Open Nozzle can and will...

- Delete the thermal layer!

- Reverse the flowpath!

- Create fresh air introduction into the idlh environment while suppression is being conducted!

- Improve conditions for everyone, especially the unprotected civilians respiratory tract. This is done by flowing water early and often! (with the right tools, methods and approach)

In Short, we can make our environment do what we want it to do!

INTRODUCTION

Everything on the Fireground involves pressure. High pressure, low pressure and the relationship between the two.

Pressure moves from high to low and introducing a stream that will not disrupt the thermal layer but penetrate and do away with it, low air entrainment volume and a reduction in temperature that creates gas contraction...makes for an effective fire attack. This can only be

accomplished with a solid stream or straight stream continuously flowing or with minor interruptions in the worst case situations.

Our attack creates a high pressure front that brings in fresh air to fill the negative void behind our stream. As this occurs we get a lift of hot gases (gas contraction) when cooled that retract smoke as well as a decrease in temperature that offers the unprotected civilian a chance at surviving. By definition, if its good for them then its good for us.

This form of fire attack is the most ethical way of firefighting that currently exists.

<u>The following is my dissertation on the matter…</u>

¨*Our primary goal in fire attack should be going to the fire room and putting the fire out. It's the conditions you are presented with on the way there that will dictate how you do that*¨.(Kyle Romagus)

It is important to understand that our arrival time at a working fire coincides with flashover conditions. *Modern rooms transitioned to flashover in 3 - 5 minutes* when UL conducted a comparison study between modern and legacy home furnishings. (ULFirefighterSafety.org)

We need to be prepared to meet those conditions with an overwhelming force acting against it.

There may be a time when flowing water from the threshold of the door is necessary for the betterment of everyone involved. The victims and firefighters that are not protected by a hoseline depend on Engine crews to be effective at changing our conditions in a positive way.

"*The greatest anti bail out tool that exists is the nozzle*" -Andy fredericks

We will discuss several concepts and indicators that are crucial for us to take notice.

- Direct Attack Vs Transitional Attack vs Indirect Attack Vs Combination Attack
- Front Door Theory
- An open door and open nozzle improves conditions for civilians and firefighters alike!
- Cornfield harvester Analogy
- Fire Behavior

- The 200 degree mark (modern synthetics start to offgas)
- The 1112 degree mark (Flashover!)
- visual cues to look for (or if there is a lack thereof)
- audible cues to look for in zero visibility
- eliminating the thermal layer
- reversal of flowpath with our stream
- Wet floors may prevent flashover!
- NFA Fire Flow Formula (line selection/ flow requirement)
- types of line advancement methods (move/ hit and move/ push) and when to use them
- What is gas contraction?
- What is Air Entrainment?
- fog nozzles have no business inside a structure fire for fire attack.
- Where do fog nozzles belong?
- Vertical Vent or Flow Alot of water

Direct Attack Method

"*The direct attack method involves applying water directly on the burning fuel to cool it below its ignition temperature and suppress production of volatile vapors" ¨ In the case of larger fires -- those approaching flashover and those already in the fully developed phase-- it may not be possible or safe to immediately apply a stream of water directly on the burning fuel. Due to burning fire gases rolling across the ceiling, high heat conditions and/ or partitions and obstructions interfering with the direct application of water, the stream must first be deflected off the ceiling and upper walls until the nozzle team can get close enough to permit direct cooling of the fuel.*

Some members of the fire service confuse the deflection of a straight stream or solid stream off the ceiling and walls with ¨ indirect" extinguishment. The purpose of directing the stream upward at 60 -70 degree angle in not to cause rapid cooling of effluent gases (which create large amounts of steam, as in the indirect and combination methods of attack) but to allow droplets of water from the stream to rebound off the ceiling and walls, penetrate thermal currents produced by the fire, and start cooling the burning fuel-- all the while the nozzle team operates from a safe distance¨

–Andy Fredericks Return of the solid stream

Andrew Fredericks was talking about fire attack in a way that was ahead of his time. When he referenced gas cooling he was talking about a wide fog style of attack (thermal balanced firefighting) where gas cooling (as opposed to cooling solids) was the main purpose or objective to conduct an advance toward the seat. Gas cooling with a wide fog as he was mentioning has dire consequences.

When we talk about gas cooling hereafter it is not in reference to small droplets converting to steam but our stream penetrating the thermal layer and rapidly cooling the surface thus creating gas contraction as a beneficial byproduct of our direct attack. By also cooling the solids like the walls and ceilings below ignition temps, we allow it to absorb heat again and not burn (exothermic vs endothermic).

By direct application of water on solids we subtract the fuel from the fire equation (The Fuel/Flame Interface). The direct attack method involves cooling the solids such as a wall, ceiling, floor or furnishing below its ignition temperature on your way to the base or seat of the fire using a solid stream or straight stream. When we make entry at our point of attack in a worst case scenario fire, we open up our stream and work from high to low. We cool overhead fire first, then work our stream away from our attack team. As we advance our way towards the seat of the fire we use our stream and reach to coat the solids in an upside down “U” or “O” pattern.

We are basically ¨Sealing off¨ the IDLH environment in front of us along with a forward assist of fresh air much like an M16 uses a forward assist to chamber another round.

By coating all sides of the box we revert it back from being on fire or prevent it from happening in the first place.

Its important to note that gas contraction outweighs the steam production from a straight stream or solid stream when conducting an interior attack.

What does this mean?

It means it is better to err on the side of flowing more water without the threat of moving around dangerous amounts of air and steam.

It means that when our stream cools our hot environment it shrinks the space that gas takes up. When gas shrinks it creates a vacuum of air to fill in the space created by cooling. If our point of entry is left open we allow fresh air to be drawn in (which is a good thing).

It also means that if we needed to we could enter a structure and flow water continuously from the door to the seat of the fire. It has been said that “its better to drown than burn as a civilian, but i've never heard of anyone drowning in a house fire”.

The Direct Attack accomplishes several goals. Surface cooling, gas cooling and fresh air introduction. It also creates a high pressure front in front of our stream causted by moving droplets being broken up against a ceiling or wall! Water moving through the air creates pressure (air entrainment), we observe that if there is high pressure in front of our stream as we cool the surface there will also be low pressure just behind it. This low pressure creates a void

that will attract a higher ambient pressure ventilation profile that can assist in fire attack (a pressure gradient is created). The large water droplets penetrate the gas layer and strike the surface thus cooling it and creating air entrainment. Water hits a solid surface, disperses and coats it then drops to the ground. Water falling to the ground and the Falldown rate is important because more water falling down to the ground means it has not gotten vaporized by the thermal currents. Water on the ground has value (see ¨wet floors may prevent flashover¨ and heat flux interruption at the floor) .

The Underwriters Laboratory Study along with Aaron Fields of Nozzle Forward was conducted in a real world scenario with acquired structures (real houses).(2018 Texas Burns UL study) His methodology of hoseline advancement/ pattern selection and surface/ solid cooling showed indisputable evidence of a back to basics approach to firefighting. Its effectiveness on cooling the environment and creating a high pressure front showed that fancy gadgets and techniques weren't needed, just old school firefighter grit coupled with basic techniques to advance hose and the direct attack using the nozzle stream.

The big takeaways from the UL study were...

-Keeping the line open while flowing maintains control over the environment.-With a flowing and advancing handline , the environment is reacting to the nozzle team, when the line is off, the fire Is doing what it wants to do.

-A flowing handline controls the heat and pressure gradient, often called the ''flow path''.

-nothing should slow down an interior attack. An interior attack is time sensitive.

Transitional Attack/ Quick Hit

A Transitional Attack is regarded as an action of opportunity in "The Evolving Fireground: Research Bases Tactics"(42) (Our Study Material). This means that if a fire presents itself to a quick exterior application of water, we should do that. The goal is to put water on the fire as quick as possible. However….

There are inherent issues with the transitional attack. The biggest one being that of angles, it is impossible to apply water to all burning surfaces of an interior structure from outside of it. This is important because we have discussed what the direct attack is and what applying water to solid surfaces does for all parties involved including the structure itself.

During the UL study on water mapping it was noted that when exterior streams are applied from a window that most of the water hits the back wall. Whatever is not coated in the center of the room or underneath other objects like a bed reignites to pre water conditions. That coupled with the area water is being applied to may not be the room of origin (the seat of the fire). If this is the case, then our Attack Team just wasted both time and water, both of which are critical to victim survival.

I would be lying if i did not discuss where the transitional attack was beneficial. If the fire was known to be located to the room of origin and ¨on plane¨, meaning at the same level as the

firefighter with the nozzle (first floor and his nozzle can reach inside the structure) then switched to half bale after a knockback. With these caveats a transitional was found to be beneficial. However there still lies the unknowns of those circumstances, in a time critical decision it is virtually impossible to know for sure that those variables exist in the right sequence. Meaning how would we know for sure that the room we apply water to is the origin fire room/ seat?

A transitional attack must be immediately followed up with an interior direct attack to be effective. It took 30 seconds for fire to rebound after a transitional attack. (UL Attack study 3 pg123) We cannot become emotionally attached to a tactic, task or technique to where it will hinder our mission.

*Exterior streams are not effective at coating all surfaces of the box to convert it back to endothermic where those surfaces can absorb heat again. The OSB/ Drywall/ Shiplap can only absorb so much heat before it catches fire or radiates it back to other solids in the room/ structure and starts catching other solids on fire in that room.

<u>By coating all sides of the box we revert it back from being on fire or prevent it from happening in the first place.</u>

Indirect Attack Method (gas cooling)

This method of fire attack was introduced by Chief Lloyd layman who also came up with RECEO VS (the fire ground priorities). His indirect attack method worked for his study on shipyard fires in enclosed compartments where the steam produced from a 30 degree fog was able to extinguish those fires more efficiently than a straight stream because the indirect method was able to convert steam efficiently with limited amount of openings in the ships. The method of attack was widely adopted after his study and publishing of “little drops of water”. What was not widely adopted was his takeaways from his study that stated

-"Indirect Attack methods, while potentially effective, have a limited range of application on the fireground and must be employed to achieve satisfactory results." -Attacking and extinguishing Interior Fires (Lloyd Layman)

-"Doors and windows in the fire building should be intact (shut), and ventilation must be delayed until after the injection of water fog has ceased" (Lloyd layman)

-"Fog streams should be remotely injected into the fire area at the highest possible level from positions outside the involved building due to the danger of steam burns to the nozzle crews."-Attacking and Extinguishing Interior Fires (Lloyd Layman)

*-“the most effective and practical method of extinguishing fires involving ordinary combustibles is by cooling the involved and exposed combustibles to a degree lower than their ignition temperatures” –Lloyd Layman of fire fighting tactics *This lends itself to the direct attack method*

“A droplet of water extinguishes flames. But the air from that nozzle can move gasses and possibly ignite gasses at a distance if the stream is not being placed on the base of the fire and if the stream has significant air movement behind it” (The evolving fire ground 37)

The indirect attack method doesn't work in a residential or commercial setting because it is very difficult to guarantee that all the openings will be kept closed for proper steam conversion.

Lloyd layman knew that sealed compartments were not possible on the dynamic fireground and that the steam produced would be dangerous to both occupants and firemen alike.

Combination Attack Method (gas and surface cooling)The Combination Attack method is classified by excess steam production and low water use. That is to say that firemen use a fog nozzle (30 degree fog) to pulse with short bursts into the gaseous thermal layer atmosphere within a structure to momentarily impede fire growth on their way to the seat of the fire. Once the seat of the fire is reached they change the nozzle pattern to straight stream and attack the base of the fire for complete extinguishment. The short pulses are meant to keep visibility intact and not produce excess stream. This is the European style of firefighting! Can you think of any dangers that may be associated with this type of firefighting? What if a window fails and a flowpath is produced. What if we don’t find the seat of the fire in time for complete extinguishment and our environment changes to untenable conditions? **With a fog pattern being introduced inside a compartment, it is basically hydraulic venting inside that compartment and moving around (PUSHING!) air, steam and fire (products of combustion).**

“*A common technique used for gas cooling while approaching a fire is the short pulse. The combination nozzle is set to a wide fog pattern (30 degrees) and the nozzle is open and closed rapidly, remaining open for less than 1 second*. ¨Figure 6.51 shows the effect of the gas temperatures in the area of the suppression crew when a utilizing a pulse technique with a fog nozzle. With less than a gallon of water, even in a wide fog pattern, had little to no effect on temperature near the approach crew. The fire compartment is also unaffected.” (UL Study: Full scale 6.12.1)

What is the answer to this dilemma? Penciling?

The answer is No

The study showed that penciling with short bursts had little effect and whatever effect did occur rebounded within 15 seconds. What happens when we move past this spot we just pencilled?

I see an issue with the combination attack. What if you did not sufficiently cool those hot fire gases above your head prior to making your way to the seat of the fire? How much water do you apply and for how long? What if you did not apply enough water to suspend the development of fire? What visual cues are you looking for? The answer is that there is no way to be 100% sure that you have done the before mentioned correctly in a dynamic environment like

a structure fire. If you choose the pencilling technique, those gases will have rebounded to pre water conditions as you move past them.

An Open Nozzle

THE STREAM- our stream selection is simple. **Only use straight stream or solid stream for attack.** This stream selection entrains a lower amount of air than a fog stream. (Reference UL Air Entrainment Study)

With heavy Fire/Smoke conditions; an open nozzle in straight stream or solid stream creates a high pressure front (in front of our stream) that penetrates and deletes the thermal layer and cools the ceiling below its ignition point. The stream disperses and hits walls and floors further cooling solids. **The thermal balance is no longer there so long as our nozzle is open**. Our stream is pushing the fire back thus controlling the flowpath!

Front Door Theory

It must be noted that positioning our attack at the main points of egress is vital for civilian survivability and access to the layout and floor plan of the structure. People are creatures of habit and will revert to what they know will be an exit in times of duress. Civilians dont think like firemen to look for flowpaths, closing doors or vent profiles. Performing an attack that has proven to be effective as well as introducing fresh air from that open door will be critical for civilian survivability. When we cross the threshold of the front door, we dont know what kind of obstacles we will run into. But we do know that for the vast majority of American households the front door is used for ease of access to the entire house. Stairs are usually nearby front doors, living rooms are near front doors which hallways and other rooms branch out from. This fact lends itself to the best point of access to apply interior streams in the best vantage point available. This paragraph is derived from the instances when our transitional attack takes us to the C side of a structure to apply quick water to fire that is showing. We burn through valuable lengths of hose and limit ourselves to access to the rest of the structure as well as taking a shot in the dark on whether the fire showing is the seat of the fire or not.

An Open Door

Leave the door we came through open when on the Nozzle Crew! Water and flowpath with air entrainment is good, no water and flowpath/ air entrainment is bad. When our stream hits the ceiling or wall it is creating a high pressure front via air entrainment and cooling of hot gases, we are also creating low pressure behind us (the door). This negative pressure gets filled in by ambient air (the gradient=everything in nature moves from high to low) this backfill of air creates a vacuum that introduces a pressure void following our stream. Cooling of solids has a byproduct of gas cooling as smaller droplets pass (larger than a fog stream) through the gaseous

thermal layer (cooled gases contract) which also gives the nozzle team lift and better visibility, but more importantly **gives trapped civilians more breathable and survivable space.**

CORNFIELD HARVESTER ANALOGY: Lars Axelson's Fire Ground priority on Rescue Vs Extinguishment

What if your kids disappeared into a cornfield and you hear a Harvester off in the distance cultivating the crop? would you?...

-search for your kids starting from one point and working your way systematically through the crop blindly?

-search immediately in front of the harvester making sure he doesn't run over them?

-Or would you simply ask the harvester to stop? Thus eliminating the threat.

By eliminating the threat of fire we address life safety by also improving our environment and victim survivability.

This analogy also applies to downed Firefighters, the duration of time it takes to set up and enact a RIT, find the firefighter, then extract him, lends itself to the decision to perform an aggressive extinguishment simultaneously while RIT is being conducted.

¨In rescuing our fellow firefighters, failure is not only an option, its a probability. The idea, the arrogance that we have that we can get them and that we would never leave them behind. That we would die trying, that we would never quit...

I got to witness this happening over and over again, when it came to that point they came up short. Heres what we learned…firefighter rescue is physically demanding, time consuming, requires a plan, requires sound firefighter skills and is prone to failure. ***Its more likely to fail than succeed.*** *We found out that weight ratios matter. A 120 pound firefighter trying to pull out a 250lb firefighter has a significant impact on your ability to succeed. We found out that it is time consuming…*

-establishing an air supply > 8 minutes

-RIT Firefighter rescue> 20 minutes

-Firefighter SCBA Air consumption <20 minutes

-Multi team RIT >60 minutes¨

-(*michael snodgrass research 1000 maydays Firextalk pdx ´16)*

What does this mean? It means we need to adhere to the Corn Harvester Analogy and put the fire out while conducting a firefighter rescue to have a higher probability of success.

At **200 degrees** modern synthetics start to pyrolyze (offgas), that is **basically pouring gasoline inside a structure**. Modern synthetics are like frozen gasoline with all the hydrocarbons suspended in them. *(Andrew Starnes- Insight Fire Training)*

Impending signs of flashover will present itself with a faint glow transitioning to fingers of flames overhead. To address this we need to **flow water now!** We can change our environment with our stream continuously flowing**. It is imperative that we train to be comfortable doing so.** This is the arena we live in and can happen in a tenable structure at any time.

When you open the door and heavy black smoke is banked down below the door knob, START FLOWING WATER NOW! It's better to err on the side of flowing more water than less.

Wet stuff don't burn... and you can dry it out but you can't unburn it -Kyle Romagus.

At **1112 degrees** (an easily attainable temp at the ceiling at most fires with modern synthetics) a smooth bore nozzle penetrates the thermal layer instantly without a large portion of its stream getting carried away by the thermal currents than would a straight stream. Less water is evaporated and more water can fall to the floor to interrupt the heat flux at ground level.This difference in required gpms for sufficient penetration is caused by the smooth bore solid stream having larger droplets than a straight stream in fog.

- **In straight stream** 75% of water evaporated at the ceiling, 12.5% was lost in the thermal currents. With 12.5 % falling to the floor.

- In Solid Stream 40% of water evaporated at the ceiling, 4% was lost in the thermal currents, 55% fell to the floor.

This difference in required water is **152 gpms on a smooth bore vs 672 gmps on a straight stream.**

(I referenced the Quantitative Approach to Selecting Nozzle Flow Rate and Stream, Part 1 and 2 by Jason Vestal and Eric Bridge)

*I think its important to be equipped and prepared with the capability to suppress the worst case scenario fire that we may be faced with. Being able to instantaneously effect our environment positively will have tangible benefits for our unprotected civilians and the morale of our firefighters.

VISUAL CUES. When the Nozzle Team passes the threshold of the point of entry, our visual cues are important indicators of what we should do. If you can see, make your way to where the heaviest smoke is and put out the fire. **If visibility starts becoming severely limited, start flowing water!**

STREAM SOUNDS. We should also listen for **audible cues** when flowing water with limited or zero visibility. We can **use our stream sounds to help us navigate inside a structure**. Our stream will change when it hits a void such as a door or window as opposed to a wall (Jay Bonnefield). A way we can discern between the two is by sweeping the floor. If there is a distinct sound of a void at the floor level most likely you have a doorway. We can use this method to systematically move through a structure and take it back room by room with flowing water at every junction and void space. Couple that with lift in hot gases and a push of the thermal layer, visibility should improve. A tic reaching the nozzle team at some point in their attack will be beneficial as well.

"we are basically going up the tailpipe and trying to stall the vehicle." Kyle Romagus

The thermal layer can be disrupted with a fog pattern but **The thermal layer will be deleted with a solid stream or a straight stream continuously flowing!**

We can **reverse the flowpath with our stream** causing a high pressure front and a draw in of fresh air behind us...

The UL Full Scale experiments showed that **"Applying water down the hallway changed the velocity (of the fire) to be completely in the direction of water application. Once the line was shut down the flow returns to the conditions prior to water application**. (Impact on Fire Attack Utilizing Interior and Exterior Streams on Firefighter Safety and Occupant Survival: Full Scale Experiments)

¨Interior attack crews with no ventilation opposite.. Figure 6.35 shows the comparison between the ¨flow and move¨ method and ¨shutdown and move method¨. With no ventilation provided opposite the suppression crew, the ¨shutdown and move¨ results in temperatures rebounding in the upper level of the hallway when the line is shutdown as the suppression crew makes their way down the hallway. This is not seen in the ¨flow and move¨ method as the hose stream is continuously cooling as the crew makes their way down the hallway.¨ (UL Coordinated Attack study 3 pg 132)

¨At the front door, on the initial flow, the velocity at the front door became all inflow, or a unidirectional vent, flowing into the structure, once the line is shut down to move forward, the door vent became bi-directional again with air flowing in at the bottom and smoke out at the top. This was noted all points when the line was opened…. Similarly, at the start of the hall,

each time the line was opened the gas velocities became unidirectional down the hallway towards the fire room. Once the line was shutdown, the flow resumed with inflow at the bottom and outflow at the top...During interior suppression, it is apparent water application has the potential to impact the flow of products of combustion. Once the line is shut down the flow returns to the conditions prior to application. Applying water down a hallway changed the velocity to be completely in the direction of water application¨.(UL Coordinated attack study 3 pg123)

Do wet Floors prevent Flashover? At flashover the upper gas temperature is 1112 degrees at the ceiling and the heat flux at floor level is 20kw/m2 which equals a heat release rate of 1 MW. The interruption of the heat flux at floor level with water will not allow conditions for a flashover. It is not a stretch in saying **wet floors prevent flashover!** In the UL Study III Full scale experiments, the panel was not able to induce flashover because the carpet was wet. New furnishings (dry) were introduced in a room and set on fire with the only variable from previous tests being that the carpet was wet.

The **National Fire Academy Fire Flow Formula**. The square footage of the structure that is actively burning divided by 3. So that is (Sqft on fire/3) will give you an estimate of the number of gpms that will be required for extinguishment. An example of this would be for us to take a 2000sqft house that is 25% involved in fire, which equals 500sqft. We would take 500sqft then divide it by 3. This equation would indicate that we need 166 gpms to put out that portion of the involved fire.

Another variant on the NFA formula is taking the square footage of involved structure . Then taking a known flow from your rig and multiplying by 3. That is to say if we take that same 2000sqft house at 25% involved. We take our first attack option and multiply by 3. A 1.75 inch line at 150 gpms will equal 450gpms. which is pretty close to our required flow of 500gpms to put out that portion of involved structure. Another example is a 2.5 at 265 gpms multiplied by 3 equals 795.....795 is the sqft of involved fire within a structure we can put out.

¨transitional attack is just fractional firefighting¨ -Ray Macormick

¨Ray said this and got alot of backlash for it...i understood what he meant,. If we look at our fireground flows and use the fire flow formula, what hes saying is if we break down our gpms into gps (gallons per second) we get this…

-Chief Howard Reinwalt

-**1.75 line @150 gpms** x3 = 480 sqft (Fire extinguishment)....

...which equals taking back **75sq ft. every 10 seconds of flow.**

-**2.5 line @265 gpms** x3 = 795 sqft (Fire extinguishment)...

....which equals taking back **132sqft. every 10 seconds of flow.**

Deck Gun @ 500 gpms x3 = 1500 sqft (Fire extinguishment)...

...which equals taking back **250sqft. Every 10 seconds of flow.**

*This Is Resetting the fire for a transitional attack. It will buy us time to make an interior attack...however (insert transitional study)

Fire Behavior (Pressures moving from high to low). (nfpa 1700)

Everything in nature moves from high to low and this is called ¨the gradient¨ and even happens at the cellular level in life. Fire acts the same way. Our stream acts the same way. An object like a drop of water moving through the air acts the same way. High pressure creation in front of matter induces a low pressure vacuum that attracts higher ambient air behind it that backfills it in.

What is Air Entrainment? Simply put, air entrainment is the observation of that piece of trash floating on the bed of your truck or someone elses you see on the highway. That is the low pressure being built up behind the cab. More specifically it is the observation that any object moving through the air creates a high pressure zone in front of itself, with a low pressure zone trailing behind. As is with everything in nature (the pressure gradient) pressures move from high to low. So that low pressure behind a droplet of water is going to attract ambient higher pressure that wants to move to fill in the void of low pressure behind that droplet. (UL air entrainment study 6.1 Air flows around a droplet pg 32)

How do we move with hose in a structure? In 1 of 3 ways. We simply **Move** from one place to another. We can also flow water- shut down then move- then flow water again which is a **Hit and Move.** Or we can continuously flow water and move simultaneously. This is referred to as a **Push**.

What situational cues would dictate when we need to use one of these techniques?

As discussed earlier our primary goal is to walk to the seat of the fire and put it out in a **MOVE**.

A **HIT AND MOVE** would be required when we flow water and have an immediate improvement in our environment and an immediate retraction of fire gases to indicate we can advance without the threat of fire rolling over our head.. This would allow us to shut down our line momentarily and move to take space from the fire and open up again. A hit an move would be required when we may not be able to move easily through a structure for various reasons like hoarder conditions or debris in the way.

A **PUSH** is required when we flow water- shut down to assess our stream impact- and have an immediate return of fire. This is a worst case scenario and requires the line to not be shut down, furthermore it would necessitate that we advanced while flowing to reverse the flowpath and reach the seat for full extinguishment.

*This should be a minimum requirement for all firefighters for bread and butter operations. Its not easy. But with training it can be done. We can teach an effective push within a few sessions of training.

Fog Nozzles

For this purpose we will discuss automatic fog nozzles with the understanding that a fixed flow nozzle would only fix one (stream deterioration) of the many variables associated with fog nozzles. The following is also considering that just by the action of advancing a fog nozzle it can be inadvertently adjusted from straight stream to a fog pattern. This is dangerous when visibility is limited and heat is present.

First and foremost.. Is the lack of penetration in a worst case scenario of **1112 degrees at flashover** and our arrival times coinciding with flashover. The big difference being the flow required from a fog in straight stream (672gpms) vs smoothbore (152gpms) to penetrate the thermal currents without getting evaporated and have sufficient water fall down to coat burning solids.

When kinked at 180 degrees (which can happen fairly easily at fires) the drop in flow was substantial on 1.75 inch hose..

-From **150gpms dropped to 55gpms on a 75psi TFT Fog nozzle**

-as opposed to **150 gpms drop to 125 gpms on a Elkhart Brass Smoothbore 7/8 tip**

* these were real world tests that i was able to do.

The **air entrainment** associated with a fog pattern. A 30 degree fog whipped vigorously with a vent behind the nozzle can entrain as much air as a PPV! 15,000 CFMs. (UL air entrainment study 6.6 pg38)

You can steam burn victims and firefighters alike.

A fog Pattern can push superheated gases and steam into other uninvolved areas of a structure which can start fires remotely I.E. **PUSH FIRE!** (The Evolving Fireground)

There is this misconception that a wide fog pattern will save firefighters in the event of a flashover. What is really going on is an interior hydraulic vent that is entraining large amounts of air of up to more than 15,000 cfms (UL Air Entrainment Study). That movement of air will push air and heat away from you but it will go somewhere else within the structure. That somewhere else can be behind you!

"**Protection Myth** Since it's my favorite, let's start with that one: protection. It will be a tremendous event in American fire service history when the entire fire service agrees, and fully understands, that what has been incorrectly referred to as "protection" for nearly 50 years, is not! A curtain of finely divided water droplets between you and a fire is not protection. The word protection, used in conjunction with a combination fog nozzle, must be replaced by another word that starts with the letter P. That word is pushing. Yes, that's actually what's occurring when a combination fog nozzle is opened
up to a cone shaped pattern: the nozzle operator is pushing all the stuff in front of him away. That stuff is heat, fire, smoke, and other nasty products of combustion." (Chief Mcgrail)

That push of superheated gases has to go somewhere else or on someone else.

It may lap behind the person on the nozzle or push fire on another firefighter or civilian. Couple that with increased oxygen introduction to the fire by your stream (firefighting practices and principles pg21).

A Fog pattern does not protect from radiant heat!

¨Radiant heat is the electromagnetic energy that does not become thermal energy until it excites the molecules of a body by striking that body. That is why water used to protect a surface exposed to radiant heat should be directed to strike and wet the exposed surface, protecting it by absorbing heat from it as fast as it is generated. It should not be directed solely to form a ¨shield¨ between the radiant heat source and the exposed body. Radiant heat will travel through the so called ¨water curtain¨ just as light does. Water absorbs thermal energy-not electromagnetic¨. (firefighting principles and practices- pg11)

The stream on the nozzle can be inadvertently adjusted

When advancing through a normally occupied structure with all the furnishings and commodities, the Fog nozzle can be inadvertently adjusted with a simple and delicate bump or twist. With the air entrainment associated with wide fog patterns this could be hazardous for all personnel involved when the nozzle is opened in a low visibility IDLH environment.

Nozzle reaction is inherently higher

On a higher pressure nozzle. 75psi for our task force tips automatics creates a 89lb nozzle reaction. This higher nozzle reaction makes advancement of hose more difficult when it does not need to be. For reference an elkhart brass smooth bore nozzle creates a 59 lb nozzle reaction for the same line at the SAME GPM!

stream deception when under pumped.

An automatic fog nozzle will build a stream from whatever pressure you give it. The built in spring will apply pressure to the stream and shape it much like a thumb over a garden hose. The stream will look the same at 55 gpms or 150 gpms much the way it did in our real world experiment!

Hydraulic ventilation can be accomplished with a Smooth Bore Nozzle at half bale.

(Which will be the loudest sound coming from the bale in a zero visibility environment)

With all of these variables... i think we can safely come up with a very rare case of a fireground absolute…

...We should never use fog patterns Interior for Attack! I will take a step further and say that if we should never use fog patterns for interior attack....it begs the question, **why have them inside at all?** They should stay on the rig for other fireground tasks except attack.

Where do Fog nozzles belong?

Hydraulic venting is best accomplished with a fog nozzle as it imparts the same amount of air movement as a PPV! Fog nozzles work great in open spaces, the heat produced from steam conversion has an unimpeded environment to escape without the threat of scalding someone in an occupied enclosed space. So Car fires, Dumpster fires, Trash fires, rubbish fires, electrical fires (electric Cars?) or any fires where you want to use air movement to push nasty smoke away from you. If an unoccupied (has to be 100% confirmed)enclosed space in a structure needs extinguishment , like an attic, cockloft or a cellar and is the only task required... a fog nozzle will be best suited for that instance. However a smooth bore at half bale will be sufficient at either hydraulic venting or able to entrain finer droplets for either tasks mentioned..

Vertical Ventilation or Flow a lot of water!

If we are not vertically venting for life or flowing large amounts of water inside a structure we are doing possible victims a disservice. When we do not vertically vent we are not releasing the pressure, products of combustion and toxic gases from the structure. That is to say the interior of the structure is pressurized and needs intervention. We have to either pop the top off of the

container or shrink the pressure built up inside of it by flowing water and creating gas contraction and air entrainment.

Fire Attack in its simplest terms is putting out fire for the purpose of saving lives. It is the blending of science and art in a hazardous environment. The act itself is both simplistic and yet very technical at the same time. It takes thousands of moving parts and just as many combinations of coordinated actions to accomplish the mission….

...And it takes an incalculable amount of brain power!

A simplistic approach to Fire Attack and nozzle work is needed and getting away from the analogy of "just another tool in the toolbox"is needed when we simply have too many variables to deal with. Instead we should be using Jay Bonnefields method for instruction, "if you see this do that". When our heart rate is elevated and its 3 in the morning our mind will revert to its most instinctual habits and basic level of training. Because truly what is the best tool in the tool box is the one that works.

"*there's no such thing as advanced firefighting*" -Aaron Fields

A back to the basics approach is needed and a refocus on our core mission as a fire service. We need to be brilliant in the basics. And no amount of books or reading can replace getting your hands dirty in training. We need to refocus on being able to deploy lines, flow water, force doors, search and throw ladders as front line Firefighters as well as being proficient at pumping. The Fire Service has always been and will always be a blue collar job!

"We have truly become jacks of all trades masters of none, we believed that service diversity was key to survival, All it has really done for us is ensure mediocrity in our performance at fires. The demands placed on our time by our diverse missions mean less time learning how to fight fires and getting to know the buildings we fight them in, we must re-evaluate our priorities...it is a disgrace. We must train like we fight."

-Andy Fredericks (FDIC 2000)

It is true that EMS pays the bills. But Firefighting is the reason for our existence. It is still branded on our chests first before being an EMT. It is still stencilled on our Apparatus. The Fire service is what has gained us the trust and respect from the taxpayer and constituency of our city for the last 167 years. They expect Firefighters to be prepared when we show up and their world is on fire. What if it was your house on fire? What would you want the firefighters

showing up to do given all that we have discussed? Would you want them to be timid and wait until they feel heat or find the seat of the fire… or would you want them to flow early and often to create and maintain survivable space for your family?

No one else is coming but us, we arent going to transfer care of that structure fire to a higher level of firefighting.

Lastly, I think we must be comfortable with failure. Failure in training. Failure in trying something new because…

... Failure is the price of admission. Because in order to fail it means you must have tried. Succeeding every time just means you only picked fights you knew you were going to win. Theres no risk involved with those victories. You cant learn from other peoples mistakes either. The sting isn't the same. The drive from impersonal failure cant fuel your motivation. I want someone next to me whose not afraid to fail, look stupid and make mistakes … Because you have to be in the game to make mistakes.

Works Cited

Fredericks, Andrew ¨The Book of Andy¨

Gray, Sean/ Norwood, P.J. “The Evolving Fireground: Research Based Tactics 2018

Fredericks, Andrew “Return of the Solid Stream” Fire Engineering 1995

¨Romagus, Kyle ¨Hierarchy of Decision making for the nozzleman¨

Craig Weinschenk Keith Stakes Robin Zevotek “Impact of Fire Attack Utilizing Interior and Exterior

Streams on Firefighter Safety and Occupant Survival: Air Entrainment” UL Firefighter Safety Research

Institute Columbia, MD 20145

Robin Zevotek Keith Stakes Joseph Willi “Impact of Fire Attack Utilizing Interior and Exterior Streams on

Firefighter Safety and Occupant Survival: Full Scale Experiments” UL Firefighter Safety Research Institute

Columbia, MD 21045

McGrail, Dave, District Chief Denver Fire Department “Smooth Bore vs Fog”

Fields, Aaron (NozzleForward.com)

Fields, Aaron (2018 Texas Burns UL study)

Fredericks, Andew “Little Drops of Water: 50 Years Later, part 1 and 2’’ Fire Engineering 2000

Lars The Sweedish Fire Nerd (Russian Analogy)

ULFSRI: Impact on Fire Attack Utilizing Interior and Exterior Streams on Firefighter Safety and Occupant Survival: Full Scale Experiments)