Flowing-and-Moving

BY NICHOLAS PAPA

The introduction of SCBA and turnout gear, which has significantly evolved since their inception, has dramatically influenced firefighting operations—a "double-edged sword." Because of the increased protection, firefighters are able to penetrate deeper without continuously flowing water, as they are no longer solely dependent on the cooling effect of the stream or the additional fresh air it entrained to "breathe off the nozzle." As a result, the fire service largely deviated from the flow-and-move approach; losing sight of the bigger picture. This gave way to the misapplication and overreliance on the hit-and-move advance, leading to a deterioration or even the complete loss of the previous skillset. By charging in further, without the timely and consistent application of water on the approach to the seat of the fire, firefighters can not only dangerously saturate their turnout gear with heat and put themselves at a greater risk of rapid fire spread/flashover and burn injuries, they also delay the unprotected victims the relief that they so desperately need to survive. Just because firefighters can and have operated in this manner does not mean that they should. The driving force behind their decision-making must remain what is best for the survivability of any trapped occupants, *period*.

After opening the access door, "staying low and letting it blow," use that time to assess the conditions. If the neutral plane is at or below the height of the doorknob and the smoke is pressurized (heat-driven), especially if turbulent, the attack should begin from the entryway. Otherwise, the nozzle team should capitalize on any visibility/tenability at the floor-level, which should be enhanced by the air exchange occurring at the doorway (lifting and leaning the space leading to the fire) and advance through the intermediate area, the travel corridor, until they are in position to initiate the attack. This should occur when the nozzle team is "on the approach"—the final 10-20-feet leading to the seat of the fire, the attack corridor (typically the junction point of the hallway or the threshold of the adjacent room), to leverage the full power of the stream and take control of the environment. The effective reach of a 1¾-inch stream in a superheated environment is roughly 25- to 30-feet. That distance is enough to clear any space in a typical dwelling.

Because of the high synthetic fuel load and the largely ventilation-limited conditions encountered, fire in the overhead can be concealed by the volume of thick, dark smoke that is produced as a result. Firefighters can no longer rely *solely* on the tell-tale visual cue of rollover, which is an imminent precursor to flashover. Furthermore, with firefighters' bodies fully encapsulated, their tactile recognition is also greatly impaired. The degree of thermal protection afforded by modern turnout gear takes a considerable amount of heat to permeate to the skin, which could allow firefighters to unknowingly crawl into an environment that desperately needs to be cooled. They cannot wait until they feel discomfort to open the nozzle. To make up for this diminished acuity of our senses, firefighters must take advantage of the insights provided by thermal imagers. It is critical to understand, however, that thermal imagers merely provide a "pictorial representation of heat," based on the relative temperature of the objects within their field of view. Using the thermal imager to correctly and accurately interpret the image on the screen requires an understanding of how the thermal imager works and what to specifically look for. A skilled operator can readily identify the thermal balance, as well as the thermal currents and evaluate their velocity to not only determine the direction of the fire, but also to aid in

gauging their proximity to it. The lower the height of the thermal balance and the faster the thermal currents are moving, the more energy (heat) is present.

If operating in zero or low visibility conditions and high-velocity thermal currents are being observed through the thermal imager, embers are falling down from the overhead, loud crackling noises are heard, and/or heat is being physically experienced, regardless if any fire (including rollover) can be seen, open the nozzle and flow-and-move from that point, as you are within the attack corridor. There are also times in this environment where there may not be any glaring warning signs, but something just does not feel right. When you are unsure as to the boundaries of the fire and you want an "insurance policy" or you have an uneasy ("gut") feeling, trust your intuitions. *When in doubt, open the nozzle; that should be your default response*. If the nozzle has to be shut down because of the terrain (e.g., clutter/hoarding conditions or otherwise tight quarters), high nozzle pressure, or any other reason, the hits should be long and thorough—maximizing the stream reach and water mapping (i.e., how well it is being distributed throughout the space)—and the intermittent movements should be short and fast, being ever-mindful of the conditions while doing so. This should only be conducted as needed, transitioning into a flow-and-move advance as soon as possible. It is important to note that conditions can immediately rebound as soon as the nozzle is shut down if base water application is not being achieved, as the stream is not reaching the burning fuels and is only knocking-back the flame front; addressing the by-products and not the source. Instead of temporarily stunting the fire ("renting" the space ahead), and giving up ground each time the bale is closed to move forward, which must then be recaptured (essentially "bunny-hopping" to the seat of the fire), flowing-and-moving, preserves the progress made ("owning" the space throughout the advance); making it a "positive-capture" fire attack. Because of its suppressive efficiency, flowing-and-moving has been proven to result in a faster knockdown with less cumulative water usage than a hit-and-move approach under the same circumstances.

When the nozzle is first opened, applying the stream into the overhead in a side-to-side or "zig-zag" pattern—moving in a wall-ceiling-wall sequence—it will pass through the hot upper-layer, cooling the superheated gases and causing them to contract. The stream will then largely ride across the ceiling and cascade down as it fans out and reaches the far walls and eventually the floor, coating and cooling those surfaces. Once the immediate area has been addressed, work the stream around in a tight ("squashed") O-pattern," focusing on the upper register, and lower it down range, periodically widening the "O" to capture the floor every few feet and sweep it of sharp or burning debris and scalding water as well as sounding it for any potential holes. Not only will this maximize the water mapping of the stream, but it will also increase the amount of air it entrains. This massive flow of fresh air—5,000 cubic feet per minute at 150 gallons per minute—can create a pressure front and seal off the attack corridor and eventually the doorway of the fire room. As a point of reference, the same volume of air is produced by the largest residential ceiling fan size on the highest setting. The influx of air can block the by-products of combustion from exhausting overhead, which are tracking toward the open entry door, and increase the intake input through the opening. If the fire room is vented, the flowing-and-moving stream can even reverse the exhaust path. The air entrainment from the stream can convert the bidirectional flow previously occurring at that entry doorway into a unidirectional flow (full intake), flowing downrange toward the seat of the fire. With a vent point opposite the handline's advance, the reversal can allow the flow of fresh air to extend throughout that pathway and re-direct the by-products out that opening, maximizing its output (full exhaust) and the benefits to both the firefighting efforts and victim survivability.

Although visibility ahead of the nozzle team (*if there is any*) will be temporarily lost, as the stream immediately disrupts the smoke layer, it will begin to restore behind them as they advance forward and extinguish the fire. By cooling the environment, causing the gases to contract, the smoke will start to lift. The by-products of combustion will also be driven away, ideally out an opposing vent opening, which will accelerate the process. If the fire is well-vented and is providing visibility that is aiding in navigating the terrain and surveying the spaces ahead, opening up the nozzle to initiate the push may be *briefly* delayed, as long as conditions remain tenable if a crew is searching the area immediately ahead of the handline. In many cases, however, these operations occur in a zero- or low-visibility environment, where only the glow of the fire may be seen. Regardless, the average push is only about 10- to 20-feet, initiated from the junction point of the hallway or the threshold of an adjoining room. Moving at a steady pace, about one step per second, the nozzle team will likely reach the fire room in roughly 15 seconds, using less than 50 gallons of water. Flowing-and-moving leverages the power of the handline's stream to overcome the fire and its by-products. By taking control of the space on the approach, you are confining the fire and reducing the thermal and toxic threat, particularly for the unprotected victims. The application of water and the additional flow of air will profoundly impact the conditions along the intake pathway. The increase in oxygen concentration, as well as the decrease in fire gas concentrations and temperatures, will greatly enhance fireground operations and victim survivability, especially when there is a vent opposite the advance and a unidirectional flow can be hydraulically induced on the horizontal plane.

Despite its long-standing tradition and proven effectiveness, both anecdotal/experiential and now scientific, there are still firefighters who question or even dispute the practicality of the flow-and-move advance. A great deal of the skepticism and arguments stem from its purpose and application being misconstrued. Although many well-intentioned firefighters attempt to advocate for flowing-and-moving, they unfortunately do so by focusing on the "how;" most often demonstrating the technique in the unrealistic environment of an open parking lot and at an unreasonable pace. The heart of this discussion, however, lies within the "when," "where," and, most importantly, the "why," which should be the starting point of the conversation. For its value to be understood and appreciated, an explanation must be provided as to the impact it has on the environment, how it benefits the fire attack and the search effort, and any trapped occupants, as well as the specific parameters for its use. Without this critical background, there is no context or intent and, in turn, the message can be misinterpreted that flowing-and-moving is being advocated for as the only approach to fire attack. What we must convey is that not every fire will require a full 10- to 20-foot flow-and-move advance to reach the seat of the fire, nor will the push always be initiated from the point of entry. The decision to implement this method is dictated by the conditions encountered and, most significantly, what will best support the firefighting operations and victim survivability.

The flow-and-move approach is most commonly attributed to the following scenarios:

- An offset room that is post-flashover with fire extending out
- Multiple rooms involved in fire
- A wind-impacted condition, where the handline is advancing from the downwind side
- A below-grade fire, where the handline is advancing down the interior stairs above
- A fire that is venting out or extending towards the point of entry

Because many of these situations are not the typical "bread-and-butter" fires, firefighters may balk at the need to flow-and-move if they have yet to encounter any of those situations personally. The problem is that the fireground is not the time or the place to have that epiphany moment. Often, there is little margin for error in these instances, which require decisive and swift action. The ability to flow-and-move can be the difference between you making the push or the fire pushing you out.

A continuous size-up to read the conditions and anticipate their progression is imperative to the initial selection of the fire attack method as well as the need for any modification throughout its execution. As with anything else on the fireground, critical-thinking and commonsense must prevail. If you can see your feet, walk as you move in. If you cannot, crouch down until you can (e.g., "duck walk"), or drop down to the floor and move in a "tripod" position. Whenever there is visibility at the floor level, take advantage of this and briefly scan the area for potential victims, the fire, and the general layout of the space prior to moving in and opening up; as the disruption of the smoke layer will temporarily obscure your vision once you apply the stream. When that "clean space" is not present, open the nozzle as soon as you enter the attack corridor and are on the approach, or the conditions otherwise warrant it. It cannot be emphasized enough that achieving knockdown requires base water application. When the stream is not reaching the seat of the fire, it is only momentarily knocking-back the burning fire gases, and conditions will begin to rebound as soon as the nozzle is shut-down. If this occurs, the nozzle must be immediately re-opened and should remain that way for the until the fire is knocked-down.

There still exists an apprehension among many firefighters to continuously flow water, if no fire is visible, even when encountering an appreciable heat condition. Much of this problem can be linked to the negative habits and assumptions inadvertently spawned out of live fire training. Because the instruction in these evolutions has historically been to advance in as close to the fire as possible, allowing for the greatest amount of heat and fire to be experienced, coupled with the flawed mantra of "do not flow water on smoke" that was professed for so many years, firefighters were programmed to advance all the way to the seat of the fire without flowing water, regardless of the circumstances. This problem is further reinforced by our PPE, which distorts our perception of the environment and its severity, since discomfort is typically not experienced until the gear has become saturated with heat. This can produce an anecdotal confirmation bias each time a fire is extinguished without flowing and moving where it was actually warranted.

Just because "the fire went out and nobody got hurt" does not mean it was the best course of action. The question we must pose is, "Were the (potentially) trapped occupants given the best chance of survival?" Despite the proliferation of phrases such as, "Another tool in the toolbox" and "It's situationally dependent," there is absolutely a hierarchy of effectiveness when it comes to the tactical options at our disposal, and *flowing-and-moving is the gold standard of fire attack*. Maximizing the preservation of life and property must remain the core metric of our decision-making. Another issue derived from live fire training is the common practice of restricting the suppression to only short bursts of water, known as "penciling," to avoid completely extinguishing the fire so it can be quickly reset for the next evolution, which, at times, may be harshly reinforced by the instructors or burn tenders. As the burn building itself becomes saturated with heat, the insufficient application of water can result in excess steam production, banking down on top of the firefighters.

These experiences create "training scars," which can lead firefighters to become hesitant to flow water. In reality, when the necessary volume of water is properly applied, the rate the fire gases contract as they are cooled by the stream (causing an immediate reduction in pressure) can exceed the rate at which the water will expand as it absorbs the heat. Unlike the thick concrete and steel walls and ceilings of a burn building, which eventually become saturated with heat and begin projecting it back out (known as "radiation feedback"), the surfaces within most residential wood-frame structures will, instead, be cooled more rapidly with less steam production. This misconception regarding steam and "inverting" the thermal layer can be furthered by the negative encounters firefighters may have had in the past, where fog streams were used for fire attack. Fire instructors must ensure they are instilling best practices as well as prompting and debriefing firefighters as to the actual conditions they can expect to encounter and the impact their tactics will have on the fireground.

Engine company firefighters must be well-versed in flowing-and-moving in various settings; as the approach will not always be a straight-forward, unobstructed hallway. They must be capable of advancing forward and backward, up and down stairs (including straight run, return, and circular types), navigating 90° and 180° turns with open- and closed-ended corners, as well as contending with restricted pathways and clutter conditions. In each of these configurations, the nozzle team must be able to make the push in tandem (i.e., married up together and advancing as one unit) and/or separated (i.e., the nozzle firefighter knee-walking while the backup firefighter provides support a few feet behind). These operations are labor intensive and require finesse, forethought, and teamwork, especially for understaffed engine companies. The associated techniques are nuanced and take proper instruction and continual practice to develop the communication, coordination, and proficiency to operate effectively and efficiently.

Sadly, flowing-and-moving is not emphasized or even included in many fire academies. Because people have a tendency to reject or avoid that with which they are not familiar or comfortable, this can also be another source of contention regarding its use. Once competent in the proper body mechanics to distribute weight, maximize leverage, and displace (reaction) force, in addition to proactive hose management, however, that daunting task, which may have seemed unreasonable or even impossible to those firefighters, can become not just a reality but one of their greatest assets. Flowing-and-moving enables an engine company to wield the full suppressive power of their handline—overwhelming and outmaneuvering the fire with the superior force of the stream and the advantageous tempo of the nozzle team. Flowing-and-moving is a matter of life safety for both firefighters and civilians alike. Not only can it restore/preserve the means of egress and the survivable space, providing cover for the search and rescue operations, but it is also essential if the nozzle team starts to get over-run or outflanked and needs to retreat under fire. For an engine company, the ability to flow-and-move is simply a requisite skill-set. An engine company must be able to operate in any environment and contend with any conditions they may encounter to reach their objective and accomplish their mission—protecting the means of egress to facilitate the search for and removal of any trapped occupants, and ultimately, extinguishing the seat of the fire; maximizing the preservation of life and property.

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