High Rise & Stand-Pipe Firefighting Operations, Fight to Win.

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High rise and stand pipe operations present departments with numerous challenges. These problems are not unique to the larger cities and preparation, pre-planning and training should be conducted by all departments, paid and volunteer, across the country. Not all communities have high rise buildings, but it is reasonable to believe that standpipe connections do exist in almost every community. Are you aware of the standpipe connections in your community? Have you identified the pressure reducing valves on the standpipe systems? Have you trained on the best procedures for using a standpipe? A working fire at 3:00 AM is no time to see your first stand pipe connection.

Across the country three problem areas have been identified in several recent high-rise fires:

- Water supply for adequate fire flows
- Functionality of fire protection and building systems
- Occupant evacuation

This article deals solely with adequate fire flows.
Several fires in recent history point out problems that contributed to both a loss of life, and significant property loss.

- Meridian Plaza, Philadelphia, PA. February 23, 1991, a fire in a 38-story building killed three firefighters and one occupant. Suppression operations were compromised by problems with pressure-reducing valves, which were improperly set during

instillation and provided inadequate pressure for fire attack using 1 ¾ inch hose and fog nozzles. The estimated property loss of $100 million and litigation from the fire amounts to an estimated *$4 billion* in civil damage claims.[i]

- First Interstate Bank, Los Angeles, CA, May 4 1988. The fire destroyed five floors and caused an estimated $450 million in damages.[ii]
- Bankers Trust Fire, New York City, Jan. 31, 1993, a fire destroyed two floors, estimated $10 million in damage[iii]

A common thread identified in the research is the lack of a significant fire flow during the initial attack. We have developed the belief that using 1¾ hose lines with combination or automatic fog nozzles is adequate in controlling these high intensity fires. That is simply not true. Chief David M. McGrail, of the Denver Fire Dept. offers this; "Fire departments must equip themselves with a low-pressure, high-volume hose and nozzles for standpipe operations. Without spending years doing research and development, they need not look far to discover a simple, cost-effective solution to this problem. The answer rests with two very basic yet effective tools that have been retired by many departments. These tools are the 2 ½ hand-line and the smooth bore nozzle."[iv]

Low-pressure standpipe systems contribute significantly to this problem. NFPA 14 (1993 edition) states that only 100-psi needs to be provided at the most remote floor outlet, and if the system was installed prior to 1993, only 65 psi needs to be provided. Keep in mind that these pressures can only be expected in a standpipe system that operates properly, is well designed, and maintained. Do you know

what buildings in your community have the pressure reducing valves set at 65 psi? Chief McGrail suggests that we should expect pressures closer to 40 psi in older systems. Critics will say that standpipe pressures can be increased to good working levels to properly supply combination and automatic nozzles once engine companies begin augmenting the system. While this is correct in some cases, permanently affixed pressure reducing valves (PRV) installed on Class III standpipe outlets will defeat any attempt to significantly augment the system. This was the experience of the Philadelphia Fire Department in 1991 at One Meridian Plaza.

The use of 2½ inch hose for all standpipe operations is recommended, and for good reason. NFPA 14 was written reflecting the use of 2½ inch hose with smoothbore nozzles. When departments decide to use 1½, 1¾ or 2 inch hose and fog nozzles, they violate the design of the standpipe system.[v] The large amount of BTUs that are being generated from a well-developed fire creates intense heat conditions requiring a large volume of water to achieve extinguishment. The use of a "big line" in residential high-rise fires is needed to overcome the oven-like conditions that result from concrete construction. The volume of flow that is produced by one or two properly placed 2½ inch lines simply cannot be duplicated by an equal number of 1¾ inch lines. David P. Fornell in his text Fire Stream Management Handbook (Fire Engineering, 1991) provides research information regarding the low-pressure capabilities of different nozzle styles. Again, the recommendation comes down to smooth bore nozzles and larger diameter attack hand-lines, specifically 2½ inch hose for high-rise and standpipe operations.[vi]

He goes on to say, "Despite the convenience of smaller hose, 200 to 300 gpm should be considered as minimum flow when working off a standpipe."[vii]

Using the National Fire Academy's (NFA) fire flow formula for calculating fire flows
[L x W / 3] let's take a look at the following scenario:

You arrive at a 2 story 200 x 100 office building with fire showing from the second floor in the left front portion of the building. It is 0200hrs and the building is closed. The building is equipped with a standpipe system. How many gpm will you need to flow through your nozzles in order to control an advanced fire in an office area comprising only 1/16th (1250sq.ft.) of the second floor?

A flow of **416 gpm** is required to extinguish this fire. What is the best hose / nozzle combination to use given the very real potential that you may have 65 psi or less at your standpipe connection?

As part of the H.O.T. training at the FDIC, participants are given the opportunity to operate hand lines based on the same standpipe operating pressures that Philadelphia firefighters encountered at the One Meridian Plaza Fire. The following layouts and hose/nozzle combinations are operated, evaluated and compared with only 40 psi at the standpipe outlet:

- 150 feet of 1¾ hand-line with an automatic combination fog nozzle provided only 37 gpm with an ineffective fire stream.
- 150 feet of 1¾ hand-line with a 15/16 smoothbore nozzle produced 115 gpm with a much more effective stream.

- 150 feet of 2½ hand-line with a 1 1/8 inch smoothbore tip produced an impressive 202 gpm with a very effective fire stream.[viii]
- A 1¼ tip will flow 293 gpm at the same pressure.[ix]

After seeing the results of the study conducted around the Meridian Plaza fire, if you had to choose a hose / nozzle combination that you wanted to use on an advanced fire in a high-rise or standpipe fitted building, which would you choose? Keep in mind that for fog nozzles to operate properly, 100 psi nozzle pressure is needed. The limitations of pressure reducing valves will effectively diminish a fog nozzle's capability rendering the fire attack weak and ineffective.

Recently, nozzle manufactures have begun to offer "low pressure" fog nozzles that will operate at reduced nozzle pressures of 75 psi or 50 psi. These nozzles are preset at the factory and are unable to be altered during a fire attack. The problem of a fog nozzle becoming obstructed with debris, trash and sediment from the stand pipe system will render these fog nozzles ineffective. Smoothbore nozzles will easily clear most sediment and debris, without reducing the fire flow. Additionally, recall what Chief McGrail, from Denver has written, "we should expect pressures of approximately 40 psi in older systems at the connection." Even with newer stand pipe systems promising firefighters 100 psi at the connection, (post 1993) when the friction loss of the attack lines are calculated, operating pressures can still be below the operating pressure of 75 psi that is required by some of the "low-pressure" nozzles.

A newer nozzle being marketed has a unique three position handle and ball to give you solid bore, fog or close positions. The nozzle is capable of operating at nozzle pressures as low as 50 psi or up to 100 psi for maximum flow.[x] However this nozzle's ability to operate at different pressures is dependant upon a number of operational factors, including water supply, engine pressure and the limits imposed by pressure reducing valves (PRV) found on stand pipe connections.
Here's is what the nozzle manufacturer has to say about their low-pressure nozzles;

OPERATING NOZZLES AT LOWER PRESSURE
100 psi inlet pressure is an industry standard applied to most fog nozzles, when operating a nozzle at reduced inlet pressure, there will be a corresponding reduction in flow, reach and reaction force.
NOTE: *It is not recommended to operate any combination fog/straight stream nozzle at pressures below 50 psi.*[xi]

What operational procedures are currently in place within your departments? If in ten minutes you are dispatched to a working fire within a structure that has standpipe connections, are you going to pull a 1 ¾ attack line? Do you have smoothbore nozzles available? As an officer would you order your crews to place 2 ½ lines with smoothbore nozzles in service? Do you as the engine driver know what the proper pump pressures are for these lines?

When discussing the differences between 2½ inch hose and 1¾ inch hose, nozzle reaction must be touched upon. Critics may try to suggest that the nozzle reaction in a 2½ hose with a 1 1/8 smoothbore tip flowing 265 gpm is too great, when in fact it is actually less than a combination fog nozzle flowing 200 gpm. Again, we can see more fire flow, requiring less work when using the 2½ line with smoothbore nozzles. Concern over the weight of a 2½ inch line must also be addressed. However; one on one the smaller hand-line cannot

duplicate the volume, reach, and knockdown power of the larger line. To deal with the added weight an Incident Commander should not hesitate to team up three, even four firefighters to place a 2½ inch line into service and ensure its mobility. Lastly, water damage is not caused by flow rate. Water damage is a result of prolonged application of water by an untrained and undisciplined nozzle team that does not know when to shut the line down. A trained nozzle team with a disciplined officer knows when to open and shut down a stream.

The United States Fire Administration in its 1996 Technical Report Series entitled Operational Considerations for High-rise Firefighting makes the following recommendation. *Since standpipe outlet pressures maybe as low as 65 psi in systems designed prior to the 1993 version of NFPA 14, or lower due to an improperly set PRV, fire departments should be prepared to make an attack under low pressure conditions. A smoothbore tip generating only 50-psi nozzle pressure should be used in these situations. Therefore, it is preferable for fire departments to carry 2½ inch hose with a smoothbore tip for high-rise operations.*[xii]

Appendix A of NFPA 14 states the following in regard to this potentially dangerous situation: *Constant pressure (automatic) type spray nozzles should not be used for standpipe operations because many of these type require a minimum of 100 psi at the nozzle inlet to produce a reasonably effective stream. The potential to flow 200 to 250 gpm at extremely low pressures is the single most important reason smoothbore tips must be used during standpipe firefighting operations*[xiii]*.*

In his thought provoking article, Do your SOPs measure up? Battalion Chief Jerry Tracy, in North Queens County of New York City points out, "The SOP (high-rise operations) should follow the most commonly accepted order of fire ground safety:

- Life Safety.
- Incident stabilization.
- Property conservation."

He continues; "Today's fire service has access to extensive information and resources that can help us in our evolution as a life safety provider of what some choose to call "customer service." Technology, science and commerce have imposed on us an increased fuel load in just about every building and room, representing for firefighters an increased presence of hydrocarbons in the burning appliances, furniture, and conveniences of our daily lives. We are experiencing fires that rapidly accelerate with increased proportions and heat."[xiv]

Many departments routinely lead off the fire attack with 1¾ inch lines for fires in structures other than private dwellings. Their advancement is often thwarted by the fire's volume and intensity or by members' incurring burn injuries while attempting aggressive attacks. The increased flows of a larger (2½ attack line) and still manageable hand-line will be more efficient in quickly extinguishing the fire instead of prolonging the time it takes smaller attack lines and reduced water flow to absorb the BTUs that today's fires produce.[xv] Hose and nozzle combinations make a critical difference in reaching and killing the fire. The increased volume, power and reach will quickly knock down the fire and preserve property while offering an increased margin of safety to affect rescues when necessary. The increased flows, reach of

stream, and reduced nozzle reaction of smoothbore nozzles are less arduous and offer superior penetration and safety from extreme heat.

The higher nozzle reactions associated with combination nozzles, which is estimated to be ½ of the total gpm flowing (150gpm produces 75lbs nozzle reaction) quickly tires firefighters. Based on my observations, in an attempt to control this nozzle reaction produced by combination nozzles a number of common inappropriate practices are occurring;

- Engine discharge pressures are reduced, effectively reducing available fire flows.
- The shut-off bales on the nozzles are being partially closed, further reducing flow.
- The pattern of the stream is being changed from a straight stream to fog patterns.
- Lines are being shut down prematurely because of fatigue.

These practices are dangerous because they do not deliver the quantity of water needed to absorb the BTUs the fire is generating, prolonging the fire's attack on structural members.

Illustrating the difference in 2½ lines between a combination nozzle set at 150 gpm, producing a nozzle reaction of 75 lbs., a smoothbore nozzle with a 1 1/8 tip flowing 265 gpm has a nozzle reaction of 75 lbs with a 50psi nozzle pressure. That is a gain of +115 gpm for the same amount of work being expended by the firefighters with an overall increase in safety, and a more effective attack team.

Is now the time to restructure your own SOPs to reflect changes that will help ensure a successful outcome and promote the highest level of safety and efficiency?

Hopefully, this clearly illustrates the advantages of using 2½ line with a smoothbore nozzle when operating in high rise and standpipe fitted buildings. I am not suggesting removing combination fog nozzles from your rigs. Fog nozzles are very useful in a variety of firefighting applications, and I do not wish to suggest that they are an ineffective tool. On the contrary, when properly employed, and pumped at the proper operating pressures, fog nozzles are a very useful tool in certain firefighting operations.
But not in high-rise or standpipe operations.

The research is clear; a specific approach needs to be made when attacking fires in high-rise buildings or those equipped with standpipes. With that I offer the following recommendations

- All fire companies need to identify and document which buildings have standpipes within their jurisdictions and endeavor to determine the settings of the pressure reducing valves. This information should be added to the pre-plan for that structure.(Pre 1993 – 65 psi - post 1993 – 100 psi)
- Develop specific high-rise packs for engine companies. Use three (3) lengths of 2½ hose-line pre-strapped into individual lengths so that each firefighter can carry one length over their shoulder or their SCBA, have the officer carry the nozzle and the standpipe connection bag.
- Mandate that crews operating in these types of buildings use 2½ inch line with smoothbore nozzles and either a 1 1/8 or 1¼ inch

tip for fire attack. Attempt to ensure a minimum of two crews assigned to this attack line to assist with line deployment and advancement.

- Train on the proper technique and procedure for advancing a 2 ½ attack line.
- Restrict the use of 1¾ lines and fog nozzles off of standpipes; pressures are too low to be effective. Using these smaller lines should be considered a serious safety issue to firefighters and occupants.
- Require company officers to conduct specific drills developed by the training section on high-rise operations quarterly.
- Require training to develop and teach fire companies the proper methods of fire attack as it relates to standpipe operations.
- Incorporate high-rise firefighting techniques into the recruit training. Several newer members of departments across the country I have spoken with were completely unaware of the points I have illustrated here.
- Provide study material (specific articles) that will aid officers in training themselves and their crews in high-rise operations.
- Drill and practice with a crew to determine their abilities to operate at a high-rise / standpipe facility in a variety of weather conditions.

Fire attack with-in buildings that are supplied with standpipes is hard work that presents significant risk to firefighters. Using proven techniques incorporating large hose with smoothbore nozzles will set the attack teams up to win the fight.

References

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