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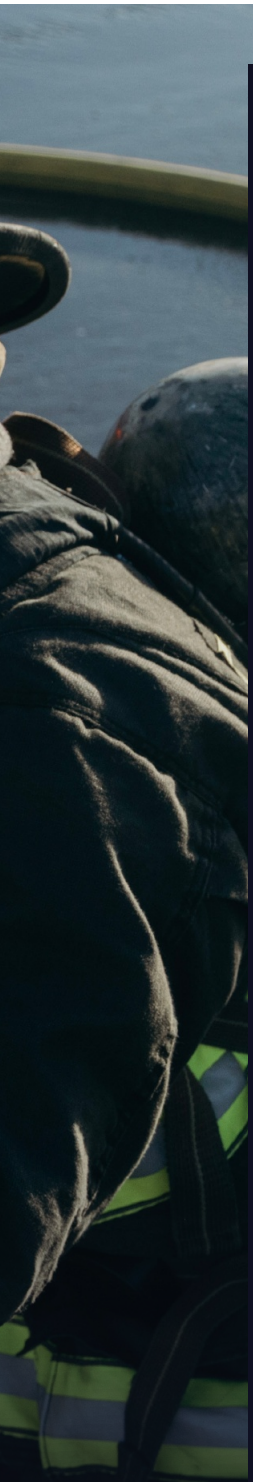
Knowledge Partner

SHAPING *the flow*

The evolution from brute force to scientific suppression requires new tools – HEN Technologies illustrates how nozzles and data systems could reshape the fireground entirely



On the modern fireground, the challenges are escalating. Fires in built environments burn faster and hotter than ever before due to the increased use of synthetic materials. Wildfires are growing in scale and intensity, and across all scenarios, there is increasing pressure to conserve water. Firefighting is rapidly evolving from a battle of brute force into a complex scientific challenge. In the search for solutions, agencies often look to large-scale equipment like fire engines or high-tech predictive software. Yet, one of the most critical and impactful pieces of technology is the one that controls the final delivery of water to the fire.

Though it may seem like a simple tool, the fire nozzle is the crucial interface between the firefighter and the fire—the final and most critical component in a long chain of equipment that determines how effectively water is applied to a blaze. For decades, nozzle design has been an area of incremental change rather than foundational innovation, often overlooked in favor of other equipment. This stagnation has left firefighters on the front lines with tools that were not designed for the complexities of today's fires.

This innovation gap is what inspired the founding of HEN Technologies. The company was established not by lifelong firefighters, but by Dr. Sunny Sethi, a material scientist with a Ph.D. in polymer physics who saw an opportunity to apply a rigorous, science-first approach to a legacy industry. HEN was founded to rethink how water is delivered to a fire, starting with the individual handline, aiming to give firefighters more control, reliability, and effectiveness. By re-examining the physics of fire suppression from the ground up, the company has revealed that modernizing water delivery does more than just improve a single piece of equipment; it has the potential to enhance operational efficiency, improve firefighter safety, and serve as the gateway to a fully integrated, data-driven future for the fire service.

The physics of failure: challenges of traditional nozzle design

To an outsider, a fire nozzle might seem like a simple tool to turn water on and off. In reality, its role is far more sophisticated. A nozzle is a precision instrument designed to convert the high pressure from a pump into a specific flow rate (gallons per minute) and shape the water into an effective stream pattern. Its performance ▸

dictates how efficiently water's heat-absorbing capacity is used to cool fuel and suppress a fire. For decades, however, traditional designs have forced firefighters into a series of difficult compromises and operational challenges.

Firefighters have often had to choose between different nozzle types that offer competing benefits. For example, a smoothbore nozzle produces a solid, penetrating stream ideal for deep-seated fires but lacks the versatility of a fog nozzle. There has not been a single solution that provides an ideal, cohesive stream across all patterns. On the fireground, these technical shortcomings translate into tangible risks. Inefficient water application means fires take longer to control, consuming more water and allowing for more property damage. The physical strain from high nozzle reaction forces wears firefighters down during long operations, increasing the risk of injury.

A modern approach grounded in science

Addressing these long-standing problems required a complete departure from traditional design methods. HEN Technologies began its journey by applying advanced scientific tools to the fundamental challenge of fluid dynamics, funded in part by the U.S. National Science Foundation. Using sophisticated computational fluid dynamics and advanced computer simulations, the company's engineers were able to model and perfect the complex water flow inside a nozzle before a single piece of metal was machined. This science-first philosophy allowed them to design a complete handline package—including nozzles, valves, and back-pressure devices—that solves the core issues firefighters face.

> **"The physical strain from high nozzle reaction forces wears firefighters down during long operations, increasing the risk of injury."**

The result is a new generation of nozzles that give firefighters unprecedented control and efficiency. These modern designs can increase fire suppression rates

The three Cs of rapid suppression

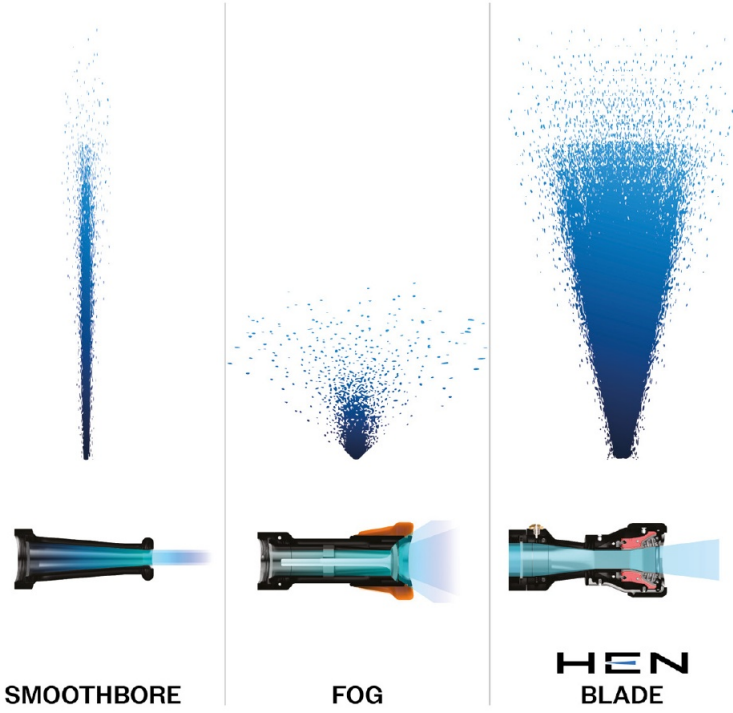
Rapid fire suppression is governed by three key principles: coverage, cooling and contraction. Each must be achieved quickly for effective knockdown, yet traditional streams rarely deliver all three at once.

Smoothbore and fog nozzles require coordinated nozzle movement to cover an area, cool effectively and contract hot gases. This reliance on manual technique adds fatigue and inconsistency.

Recent advances, such as the blade stream, change this dynamic. Its pre-broken, linear droplet pattern delivers wider coverage with simpler sweeps, reduces strain on firefighters and enhances operational proficiency.

By interacting with a larger volume of heated space, the blade stream improves cooling, contracts hot gases more effectively and stabilizes conditions faster. Its design makes suppression more intuitive, accessible for both experienced firefighters and new recruits, while conserving water.

while reducing water consumption. This is achieved by optimizing the water droplet size and stream cohesion, ensuring that the maximum amount of heat is absorbed with every gallon deployed. This design philosophy also extends to the human factor—the firefighter who has to operate the equipment for extended periods. By carefully managing the internal fluid dynamics, modern nozzles can dramatically reduce the nozzle reaction force without sacrificing hose stiffness. This makes the hose line easier to control and significantly reduces physical strain, improving both safety and endurance during long incidents.



"Inefficient water application means fires take longer to control, consuming more water and allowing damage."

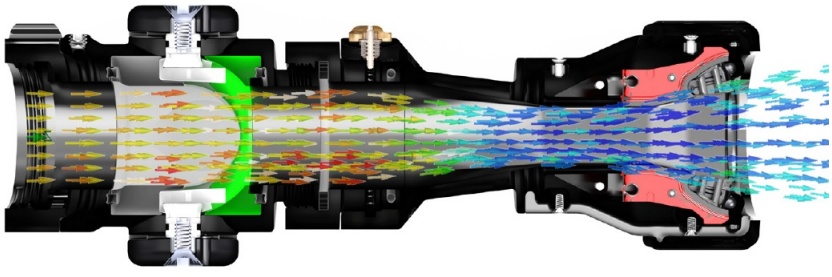
From handlines to master streams: scaling the innovation

After proving that a science-first approach could revolutionize the handline, the logical next step was to address a much larger challenge: the master stream. Master streams, which are mounted on engines or used as portable monitors, deliver significantly higher volumes of water and are critical for large-scale defensive operations. However, these systems suffer from the same fundamental flaws as their smaller counterparts, but on a magnified scale. Poor stream quality, limited reach, and inefficiency are even more pronounced when dealing with flows of 1,000 GPM or more.

Applying the learnings from their handline technology, HEN developed the Titan master stream system. The core advantage was understanding that the principles of fluid dynamics don't change with scale, but the engineering challenges do. By applying their proven simulation and design process, they engineered a system that delivers a highly cohesive and effective stream over greater distances. This means more water reaches the intended target with less waste, increasing the overall effectiveness of large-scale water delivery. The Titan represents a crucial step in HEN's evolution, proving that their design philosophy is not limited to a single product but is a scalable platform for solving the fire service's most complex water flow challenges. This progression from hand-held tools to heavy-duty mounted systems was the final piece of the hardware puzzle.

The Gateway to an Intelligent Future
Modernizing the full spectrum of water delivery, from handlines to the Titan master stream, is about more than improving the tools themselves—it's about laying the groundwork for the future of firefighting. HEN's vision extends far beyond hardware; the company is building an intelligent platform to transform fire suppression from a series of manual, disconnected actions into a coordinated, data-driven operation. The next generation of HEN's products is being designed with integrated sensors. This technology is the foundation for HEN's Fluid-IQ platform, an AI-powered operating system. It will enable smart pump controls.

Fire defence is a critical component of homeland security, and its modernization is a significant national priority. HEN's vision aligns directly with this objective. By developing technologies like the Blade, Titan, and Fluid-IQ platforms, which are rooted in deep foundational science, HEN assists fire departments in solving the complex, multi-tiered problem of fire suppression. This approach empowers departments to contribute to and benefit from a modern and secure national fire defence infrastructure. ■



HEN Nozzle Fluidics