The Fire Rebels

They're taking on the American firefighting establishment with a precision method of dousing flames. The hot new way to save lives and burning buildings: bursts of delicate fog.

By Joshua Davis

Ed Hartin has an impressive firefighter's mustache. From the corners of his mouth, it stretches out to his jowls like an umbrella protecting his lips. It doesn't exactly fit him. Most of the time, he cultivates the air of a college professor - he's studying part-time for a doctorate - and he admits to a fondness for Wagner. But sometimes you need a big mustache to get other firefighters to listen to you.

"The fire service in the United States is a 200-year-old institution unimpeded by progress," Hartin tells a group of firefighters at a training center in Gresham, Oregon. He's the battalion chief in charge of training in this small town bordering Portland. It's a cool spring morning, and 20 feet away fires blaze inside two steel shipping containers. The men are clad in full battle gear: face masks on, air tanks flowing, helmets strapped, and hoses ready.

Hartin explains that humans have been "putting the wet stuff on the red stuff" for centuries, without really analyzing the effects. What's been overlooked is the fact that the invisible gases produced in a fire can be much more dangerous than any flame. Especially in enclosed spaces, these gases tend to become superheated, flammable, and highly mobile. The result: backdrafts, flashovers, and gas explosions - the three main varieties of so-called extreme fire behavior. Every year, scores of firefighters around the world die because they've been trained to deal with this volatile mix of physics and fire gases by using an old-fashioned strategy: duck.

Hartin thinks it's time for a change. He's the first fire chief in the US to embrace a tactic known as 3-D firefighting - 3-D because it takes into account the gases that fill a room, not just the surfaces of the structure on fire. Using thermal-imaging equipment, firefighters gauge the thermodynamics of a blaze and then attack both the seen and unseen elements using split-second

pulses of fog. In Sweden and Britain, where it is now part of the official firefighting method, 3-D has led to a more than 50 percent drop in fatalities caused by extreme fire behavior.

But the technique has been slow to catch on in the US, in part because it challenges the classic American image of firefighting. American firefighters have been trained to unspool massive hoses, kick down doors, and spray the hell out of anything that looks like a flame. The Europeans are suggesting a more nuanced approach involving delicate clouds of mist.

No wonder it has been a hard sell. "You've been using your fire hose like a chain saw," Hartin says quietly to the trainees, like a supremely confident kung fu master. Smoke billows out over his head as the container behind him erupts in flames. "I am going to teach you to use it like a scalpel."

Mike Traeger, a 16-year veteran of the Gresham department, says he used to laugh at Hartin and his Zen-like pronouncements. That changed one warm afternoon last fall. Traeger was responding to a residential garage fire, and he and his partner, Steve Sager, approached from inside the house. When Traeger opened the door to the garage, a wall of heat and gas roared out.

Sager hit the fire with a traditional stream of water, which shot right through the room to the back wall, doing nothing to cool the gases swirling near the ceiling.

Traeger slammed the door shut and could sense the gases pressing against the structure's skin. He recognized the signs from Hartin's lectures: The gases were building up in the garage, and their temperature was spiking. Traeger and Sager were crouching on the downstream side of a dam that was about to break. Traeger's old-school training told him to run. They might make it out; they might not. Either way, the house would surely be destroyed. Perhaps, Traeger thought, now would be a good time to try something new.

He took the nozzle from Sager, whom he outranked, and told him that they were going to try Hartin's method. Sager opened the door for a fraction of a second and Traeger set the nozzle for fog and fired a quick burst at the gases. They did it five times, cooling the gases and containing the fire long enough for another engine company to pierce the exterior garage door and smother the blaze with a massive application of water. Not only did Traeger and Sager ensure their own safety, they also prevented the rest of the house from burning down.

Over the last three decades, building materials have changed dramatically. Plumbing, flooring, siding, roofing - most are now made from synthetics. The same goes for the stuff inside the building, like foam rubber seat cushions, plastic computer cases, and nylon carpet fibers. As a result, today's blazes produce two to three times as much energy as a typical fire did in 1980, and most of that energy emerges as flammable gases. Those gases don't escape from newer buildings, which are well insulated and tightly sealed. Fires now project their energy much farther from their cores, making them more dangerous and more difficult to extinguish.

Krister Giselsson and Mats Rosander, two Swedish fire engineers, predicted this problem in the late 1970s and began developing new methods to address it. They realized that just approaching the fire - getting close enough to put the wet stuff on the red stuff - was going to be the defining challenge of 21st-century firefighting.

Their solution contradicted one of the oldest rules in the business: Don't put water on smoke, particularly when there are firefighters nearby. The water will turn to steam and cook everyone. But the Swedes argued that if the water is broken into tiny droplets and deployed in extremely brief bursts, the moisture's expanded surface area will cool the gases in the smoke without turning to steam. So instead of simply ducking, firefighters could continue to push forward to the source of a blaze.

It worked. In Sweden, the number of firefighter deaths dropped from 10 (1970 to 1985) to 5 (1986 to 2005). In the UK, which adopted the 3-D firefighting approach in 1997, the results were even more impressive. The British fire service lost 12 members as a result of extreme fire behavior in the years 1990 to 1996. From 1997 to 2003, not a single firefighter was killed due to extreme fire behavior. And after a series of flashover deaths in France in 2002, the French Ministry of the Interior made *attaque 3-D* its official training methodology.

In 2002, Gresham became the first US city to adopt the technique. It happened because the fire department is small enough to be nimble - 85 full-time firefighters serve an area with 130,000

people - and because Hartin is unusually experienced, curious, and determined. He's worked in departments throughout the country and spent three years as a training officer at the National Fire Academy in Maryland. One day he stumbled across the Swedish approach while Googling "fire behavior." He ended up contacting Giselsson and Rosander and arranged to fly to Stockholm to learn 3-D firsthand.

Hartin returned home from Sweden more convinced than ever that firefighting can - and should - evolve. By clinging to traditional methods, he argues, US fire departments are needlessly endangering firefighters' lives. In 1983, he notes, there were 3.4 US firefighter fatalities per 100,000 fires. In 2002, the most recent year for which data is available, the rate was 3.5. That represents 101 fatalities each year, about a fifth of them due to extreme fire behavior. "We're not getting any better at this, and that's ridiculous," Hartin says.

Such arguments don't impress the American firefighting establishment, which is firmly against the European approach. In 2003, *Fire Engineering*, a leading US firefighting journal, published a damning three-part series that questioned using fog or mist to fight fire. The authors evaluated the technique by performing a series of tests, all of which, they concluded, showed that the fog would endanger firefighters. Life-threatening amounts of steam were produced, they reported, and the mist created massive airflow in the fire chamber, forcing 2,000-degree air near the ceiling down toward the firefighters. The tactic was referred to as a "spray and pray" method that would create "fireman's soup," in which "firefighters are the main (painful) ingredient."

The articles infuriated Ed Hartin. In the tests, a continuous stream of fog was used, not the short bursts advocated by Hartin and the Swedes. Coauthor Tim Pillsworth admits none of the authors had studied or trained with a 3-D firefighting expert. They learned about the approach by reading a manual and scanning Web sites on the topic. That was plenty of information, Pillsworth says. "To cool something down, you need to put a substantial amount of water on it," he says, "not shoot out a puny little fog stream."

While Gresham and a few other small departments, such as Prince William County, Virginia, and Clackamas County, Oregon, have moved toward the more complex firefighting technique, big-city departments like those in New York and San Francisco are going in the opposite direction. This summer, San Francisco will complete its transition from combination nozzles - ones that can produce both a straight stream and fog - to smooth-bore nozzles, about as low tech as a nozzle can get. They are simply tubes that deliver a solid stream, which allows for faster flow and requires less maintenance.

Smooth-bore proponents like Tom Siragusa, San Francisco's director of firefighter training, scoff at 3-D techniques. "How are these little drops of water going to penetrate through the smoke and heat to get to where the really hot stuff is?" he asks. He advocates "penciling" - running a solid stream of water along the ceiling to cool rising gases.

To Hartin, this is nothing but a version of the classic, doomed response. "Firefighters don't like to talk about science and theory," Hartin says. "They are tradition-bound, practical people, but each time they see one of their buddies survive something he shouldn't have because of the new methods, we'll gain acceptance."

Gene "Mad Dog" Murray suits up with Station Number 71 at the Gresham fire-training facility and prepares to fight another Hartin inferno. Every week, Hartin builds a made-to-order fire and sends his crew in. Recently, he told them to sit on the floor of the container as the fire roared all around them. They sat for 15 minutes in silence, simply looking at the flames.

Murray, a 20-year department veteran, readily admits that he thought Hartin had lost his mind when he got back from Sweden. "We're firefighters," Murray says. "We don't observe fire, we fight it. For a long time, we just thought he was crazy."

For today's exercise, Hartin ignited a stack of wood, particleboard, two-by-fours, and shipping pallets at the back of the container. Clouds of black smoke roll out of the cracks at the top of the container's door. Today's lesson: seeing the invisible.

Murray lifts a $10,000 thermal imager. It's a rounded, handheld device with a penny-sized sensor on one side and a color screen on the other. Point it at the container and the device reveals the shape and temperature of the streams of hot gases seeping out of the door cracks.

Before he started listening to Hartin, Murray says, his approach was to "crawl low till you find the glow, and just hope that it doesn't blow." The fire that Hartin has brewed up today is meant to reveal the weakness in that technique. Using the thermal imager before entering, Murray identifies the fire source within the container and then tracks the gases streaming along the ceiling toward the door. If he doesn't try to cool the gases - if he just crawls low - there is a risk that the gases will ignite when he's halfway down the corridor, causing the entry door to turn into a wall of fire. He'd be trapped in a very hot and narrow passageway.

Instead, Murray makes his way into the container behind rapid fog bursts, inching toward the source of the fire while he cools the overhead gases. The cooling condenses the smoke, lifting it closer to the ceiling and improving visibility. "Fire sharks" - pockets of igniting gas - nip at the edges of Murray's fog clouds and retreat backward. When he is within 15 feet, he hits the fire source with a solid stream of water, which extinguishes it immediately. "I used to just react. Now I actually control a fire," Murray says. "You look back at it, and you wonder why we weren't doing this 20 years ago."

Hartin smiles. "In the fire department, change is a bad word," he says, walking into another container with a propane blowtorch. In a few seconds, smoke is pouring out the door.

Fighting Fire the 3-D Way

When synthetic materials burn in enclosed spaces, they emit superheated gases that can be even deadlier than flames. "3-D" firefighting attacks more than just the surface of a building - crews use bursts of fog to cool the invisible gases, letting them get close enough to douse the blaze.

1. Firefighters approach the front door of the apartment and use a thermal imager to check for the presence and temperature of hot gases building up inside.

2. Opening the door briefly to minimize the flow of oxygen into the hall, a firefighter sprays a burst of fog to cool gases and prevent flashover, backdraft, or explosion.

3. With the gases cooling, the hall is now safe enough to enter. Repeated bursts of fog further reduce smoke and gases as the firefighters advance toward the flames.

4. Once close enough to the source of the blaze, the crew applies a direct stream of water, extinguishing it.