FRONT BURNER

Commercial products designed to mitigate cooking fires—the primary cause of home structure fires—have so far failed to go mainstream, but research efforts to develop testing standards for the devices hope to reverse that trend

BY FRED DURSO, JR.

At the Hughes Associates research facility in Baltimore, Maryland, engineers are conducting experiments on a plain white electric stove. Tubes and wires are hooked up to the appliance, giving it a kind of hospital-patient look. A frying pan containing cooking oil heats on the stovetop, and gauges monitor the temperature of the pan as the oil reaches the point of ignition. As fire shoots from the pan, sampling ports in a collection hood over the stove analyze the oxygen, carbon dioxide, and carbon monoxide levels of the smoke and gases emitting from the flaming pan.

Hughes, a fire protection and engineering firm, is one of a handful of companies and institutions currently analyzing methods to mitigate cooking fires, which are the leading cause of home structure fires and associated injuries in the United States, according to NFPA. (See "Kitchen Nightmares," page 63.) The goal of the Hughes project, which is being conducted under the auspices of the Fire Protection Research Foundation and supported through a grant from the National Institute of Standards and Technology (NIST), is to help develop standardized fire scenarios and performance test methods for cooking-fire mitigation technologies, which the Foundation believes is a crucial step in furthering the use of these technologies.

Efforts to reduce the deaths, injuries, and property damage associated with these fires are not new; groups such as the International Association of Fire Chiefs have raised the issue for years, while NIST, the Consumer Product Safety Commission

ONLINE

nfpa.org/cooking_research

Download the "Home Fires Involving Cooking Equipment" report.

Download the "Home Cooking Fire Mitigation: Technology Assessment" report.

Learn more about NFPA's Fire Prevention Week theme, "Prevent Kitchen Fires."

Watch video interviews with Hughes Associates engineers responsible for the "Home Cooking Fire Mitigation: Technology Assessment" research.

Photograph: iStockphoto

(CPSC), and others have been developing strategies since the 1980s to mitigate cooking-related fires. New cooking fire mitigation technologies—devices placed on and around stovetops that alert cooks of danger and alter cooking mechanisms before catastrophe occurs—have entered the marketplace in recent years, and their potential is receiving attention from researchers and home fire safety advocates. According to a 2011 report prepared for the Research Foundation, those products include detection and suppression systems, motion sensors, and alarms to prevent unattended cooking, as well as contact temperature sensors to prevent food ignitions.

Even as more of these products are brought to market, though, they remain slow to appear in U.S. homes. That's the result of a number of factors, including the absence of standardized testing methods to evaluate new products. Without those standardized methods, there is no uniform way to distinguish effective mitigation products from ineffective ones, and consumers have no independent seal of approval with which to purchase cooking-fire mitigation products. Testing standards are also seen by some as an essential step toward the possible future regulation of such devices, and as a possible tool for the type of public cooking-fire awareness campaign that NFPA is gearing up for.

OVER THE YEARS, MANUFACTURERS HAVE DEVELOPED A VARIETY OF APPROACHES DESIGNED TO MITIGATE COOKING FIRE DAMAGE.

"We haven't characterized the fire scenarios, and we don't know what the performance criteria are for these cooking-fire mitigation technologies," says Kathleen Almand, the Research Foundation's executive director. "This new project is an important step toward widespread acceptance of the commercialization of these technologies."

The Foundation's partnership with Hughes isn't the only project addressing the issue of testing standards for cooking-fire mitigation technology. Other current research endeavors, including work being done at Eastern Kentucky University (EKU), Underwriters Laboratories, and the CPSC, have related scopes and goals.

"Important parts of the fire world are focusing on cooking fires in order to limit them," says Corey Hanks, a researcher on the EKU project. "Finally, we're seeing more of a push."

Simmering subject

Over the years, manufacturers have developed a variety of approaches designed to mitigate cooking fire damage. Some devices use motion detectors to check for a cook's presence at the stove and can shut off the burner if nobody is nearby. Other devices release suppression agents on stovetop flare-ups, use smoke alarms to predict pre-fire conditions, and can prevent oil from reaching its ignition point. (For a list of technologies, see "Come on Baby, Mitigate My Fire," page 61.)

NIST approached the Research Foundation in 2010 with a request that it develop an action plan that would further the implementation of these devices. The outcome was the Foundation's 2011 report, "Home Cooking Fire Mitigation: Technology Assessment," which was prepared by Hughes for the Research Foundation and evaluated more than a half-dozen categories of technologies based on fire prevention effectiveness, cooking performance, cost, and convenience.

So-called tin-canister suppression systems—which use chemical suppression to control stovetop fires, and are mostly found in commercial applications—are the most common type of cooking-fire suppression system in use. Of the newer technologies, the pan-temperature sensing type is the most prevalent in the United States and includes devices such as the Safe-T Element, which is designed for electric-coil ranges and includes a solid plate cover retrofitted atop the burners. The system, which requires professional installation, includes a unit inside the stove that prevents the plate from exceeding 662 degrees Fahrenheit (350 degrees Celsius), far below the ignition temperature for most oils and fabrics. Since its release in 2007, more than 90,000 Safe-T Elements have been installed in multi-unit housing developments, universities, and military housing across North America, a result of the Assistance to Firefighters Grant (AFG) program that allowed local fire departments to purchase the devices. To date, there has never been a stovetop fire on a range equipped with this technology, says Kevin Callahan, president and CEO of Pioneering Technology Corp., which produces the Safe-T Element.

While some companies, including Pioneering Technology, have developed their own safety evaluations for their products, the absence of any standardized test methods is a problem for many manufacturers, according to Dan Madrzykowski, who leads NIST's Firefighting Technology Group. "If there was a device someone wanted to bring to the market, how would they test it?" asks Madrzykowski. "That's what the Foundation's research is doing—developing an appropriate test to make sure a device is doing what it claims to do." Madrzykowski has also contributed his expertise to the Vision 20/20 Project (strategicfire.org), an effort launched in 2006 by the Institution of Fire Engineers–U.S. Branch and funded by several AFG grants, which is designed to unite individuals and organizations, including NFPA, in developing a national strategy for fire prevention, including cooking fires. The Foundation's current project related to cooking fire mitigation technology was an outcome of a need expressed at a Vision 20/20 workshop.

Madrzykowski equates the slow adoption of mitigation technology to the implementation of seatbelts and airbags in cars. "One of the challenges of changing what you're doing now to something different, regardless of the business, is admitting that what you're doing now may include aspects that could be considered hazardous," he says. "To be fair, the other thing you don't want is to be an early adopter of technology. Before you start making a million units and placing them in American homes, you want to make sure it really works."

Experts also point to the possible effects that mitigation devices could have on cooking quality as an issue that will need to be addressed. A device that activates too early, for example, or is too sensitive will require a cook to restart cooking repeatedly, which will not only be frustrating and time-consuming but could also degrade the quality of some cooked food. While it may not be necessary or practical to include this aspect in routine testing, researchers say there will need to be some level of proof of acceptable performance in this area if the devices are to move beyond token use.

Almand of the Research Foundation says stove manufacturers are engaged in the latest research efforts; the Association of Home Appliance Manufacturers (AHAM), for instance, is a member of the steering committee for the Foundation's

Come On Baby, Mitigate My Fire

A primer on some of the technologies designed to reduce cooking fires

A lack of standardization for evaluating cooking fire technologies hasn't stopped manufacturers from developing products for commercial and consumer use. Here's a selection of devices currently on the market, taken from the Fire Protection Research Foundation report, "Home Cooking Fire Mitigation: Technology Assessment."

Motion detectors
A motion-sensing device determines if a cook is present when an electric stove burner is on. If there's no movement, the sensor begins a countdown and sends visible and audible warnings after a determined amount of time. The power is cut off to the stove if the cook doesn't respond to the alarms. Another motion-sensing device automatically shuts off a stovetop when the cook isn't present.

Contact burner temperature and sensor control
This device includes a cast-iron plate that is placed over electric coil burners. Another component placed inside the stove regulates the plate's temperature so it doesn't surpass a specified value, thus preventing the ignition of food and other products from unattended or careless cooking.

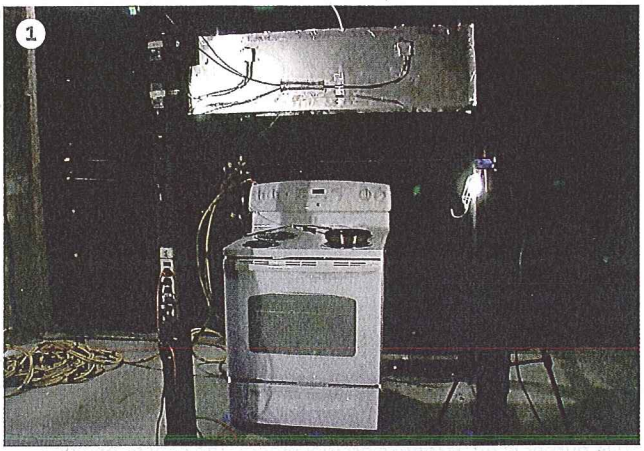
Over-range temperature sensor with burner control
A sensor is mounted to an exhaust hood and monitors high temperatures that could mean overheating or that burners have been left on. Once an alarm sounds, another device cuts electricity to the stove's burner.

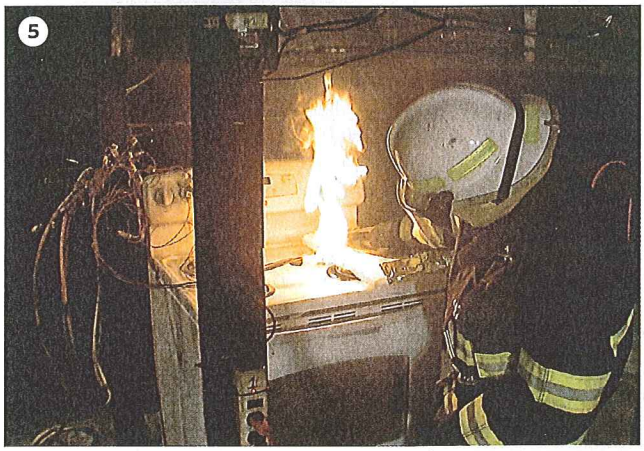
Smoke detection with burner control
Equipped with either a photoelectric smoke alarm or a combination photoelectric/ionization alarm, this product includes an electrical control device that cuts off a stove's electricity when the alarms are activated. The electrical control mechanism can be configured to use other alarm devices, including gas, heat, and other smoke detection devices.

Induction cooktop
Unlike gas burners and electric coils, induction cooktops use a magnetic field that produces an electric current to heat cast iron or stainless steel cookware. Only the cookware—not the cooking surface—gets hot, reducing the potential of the ignition of nearby materials. Moreover, burners cannot be accidently turned on, since the stovetop operates only when a piece of ferrous cookware is placed atop the burner.

Kitchen suppression system
Due to their size and expense, these systems are typically intended for commercial kitchens and may include exhaust hoods, temperature detectors, chemical or water suppression systems, and the ability to cut off a burner's gas flow or electric current. Home versions do exist, however, and use a heat-activated device attached to a vent hood that discharges a sodium bicarbonate extinguishing agent.

—Fred Durso, Jr.





HOT PAN Researchers with Hughes Associates have been conducting experiments to develop a standardized test that evaluates cooking fire mitigation technologies.

❶ A testing stove and collection hood inside a Hughes research facility in Baltimore, Maryland. ❷ Cooking oil is poured into a frying pan equipped with thermocouples that measure fuel and pan temperatures. ❸ The oil reaches its ignition point. ❹ As the oil burns, lasers in the collection hood measure the smoke concentration as sampling ports measure oxygen, carbon dioxide, and carbon monoxide concentrations. ❺, ❻ A technician extinguishes the fire using a lid and flameproof material.

Images: Bob Finn

new project. "AHAM has been very supportive of the most recent research project being conducted by Hughes Associates," said Wayne Morris, vice president of Technical Operations and Standards for AHAM, in a prepared statement. "We appreciate that the Research Foundation has involved a large number of stakeholders, government agencies, standards developers, and the manufacturers to discuss a solution."

Up to the tests

Besides assessing various types of fire mitigating technologies, the Foundation's 2011 report also outlined future endeavors, including the development of what it termed "standard fire scenarios" and the creation of "test methods and performance criteria." These objectives are now being addressed by the Hughes researchers, who began testing in April on an array of cooking oils, including varieties with higher free fatty acid compositions that can ignite at lower temperatures and therefore may lead to fire sooner. Factors also under investigation that might impact the oil were the size and shape of the frying pan as well as the burner's power output; mitigation technologies themselves were not tested during this research. Electric coil ranges—the most prevalent type of ranges involved with cooking fires, and the type that current available mitigation devices are designed for—were used exclusively during the experiments, but Almand says the test methods, once validated, may apply to gas and other types of ranges as well.

"The goal is to identify an appropriate cooking event that could lead to a potential fire, and do this in a way that is reproducible and represents the most challenging conditions to a range of technologies out there," says Dan Gottuk, senior engineer and director of forensic and litigation services with Hughes and project supervisor for the new Research Foundation project. Hughes completed its testing in June and anticipates issuing a report later this year.

Similar research is underway at Eastern Kentucky University (EKU). Funded by Vision 20/20, the project analyzes auto-ignition temperatures of nine fuels heated atop four types of stovetops, including one equipped with the Safe-T Element. Researchers characterized the heat output of six- and eight-inch pans placed on burners at low, medium, and high settings. Fuels were added to the pans, and thermocouples, or temperature gauges, were placed inside the pans and directly above the fuel to determine "the heat being transmitted … and how it affected the top surface of the material being heated," says the EKU researcher Corey Hanks. A report on the findings is anticipated later this year.

Another study by Underwriters Laboratories and the University of Maryland aims to pinpoint predictors that could prevent flaming stovetop fires. Oxygen and gas concentrations at the stove's burner, the stove's hood, and kitchen ceiling levels were analyzed during 11 scenarios, including frying bacon and cooking ground beef. The research, says Almand, might inform the development of specific types of detection devices near the stove that alarm when pre-ignition conditions are present.

Other countries have already incorporated certain types of mitigation technology. Some stoves in Japan, for example, require temperature-regulating devices that cut power to the cooking surface if it approaches specified ignition temperatures, says NIST's Madrzykowski.

Similar code-driven requirements, supported by standardized testing, may appear in the United States in the future, Madrzykowski says. "Once a standardized test for a cooking implement is available, you may see something from the codes and standards arena, where you have states and localities saying, 'All homes need to meet this standard,'" he says. "That's down the road—it's certainly not happening in the next three to five years—but there's certainly potential for that."

Meanwhile, NFPA is looking for additional ways to have a greater impact on the cooking-fire problem, says Lorraine Carli, NFPA's vice president of Communications.

"Conventional home fire sprinkler systems can certainly be effective with cooking fires, but we also recognize the importance of technology that can prevent these fires in the first place," says Carli, noting that injuries tend to occur early in cooking fire events and close to the source. In addition to research and a continuing public education push, she says, there is also a need for better collaboration with other organizations. "A lot of the issues related to cooking fires and cooking-fire mitigation that are bubbling up here at NFPA are bubbling up elsewhere," she says. "More organizations are seeing this as a shared concern."

FRED DURSO, JR. is staff writer for *NFPA Journal*.

Kitchen Nightmares

Of the more than 157,000 estimated home structure fires reported annually during the period 2006–2010, cooking caused 42 percent of the fires, 38 percent of injuries, and 15 percent of deaths.

Unattended cooking was the leading contributing factor to these fires and fire deaths.

Ranges, with or without ovens, accounted for the majority of home cooking fire incidents.

Three of every five non-fatal home cooking fire injuries occurred when the victims tried fighting the fire.

Frying poses the greatest fire risk.

Source: NFPA's "Home Fires Involving Cooking Equipment" report.