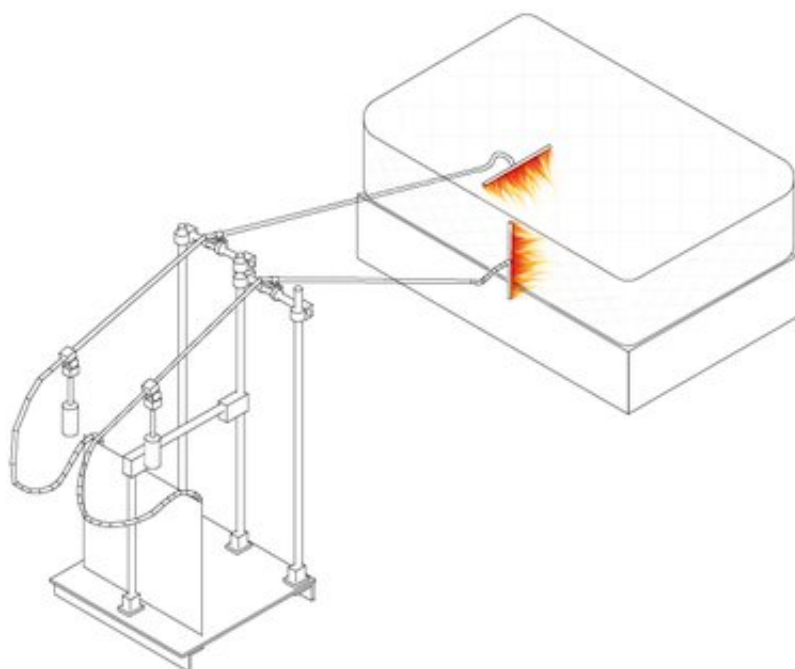


Mattress flammability standard is a lifesaver, NIST report finds

November 18 2020



The test setup described in 16 CFR Part 1633 entails applying gas burner heads to the side and top of a mattress for up to 30 minutes. Credit: B. Hayes/NIST

No matter how soft and cozy, beds that have gone up in flames are a source of some of the deadliest fires in the U.S. As large pieces of furniture loaded with combustible cushioning materials, beds are substantial fuel sources for home fires. Once ignited, mattress fires can grow quickly, creating life-threatening situations in bedrooms or entire houses within minutes.

A 2007 standard for [mattress](#) flammability from the Consumer Product Safety Commission (CPSC), known as 16 CFR Part 1633, sought to curb the danger of bed fires sparked by flames, which caused an estimated 95 deaths annually from 2002-2005. But because of how infrequently consumers replace mattresses, the researchers who helped to develop the standard spent years in the dark about whether the safety requirements were living up to expectations.

Now, enough data has accumulated for researchers at the National Institute of Standards and Technology (NIST) to estimate that the standard prevented 65 deaths from bed fires annually in 2015 and 2016. That number is expected to rise as more mattresses are replaced with the newer, standard-compliant models.

"What we've got here is a clear case of [fire](#) researchers, manufacturers and regulators all working together, getting the science right, getting commercially acceptable versions of the mattresses right and getting the regulation right," said NIST research scientist Richard Gann. "It all came together, and as a result we have a real success story for the country."

Long before 2007, other standards were in place to crack down on a leading cause of bed fires in cigarettes, but they left the grave threat of flaming ignition sources, like lighters, matches or pieces of burning furniture, largely unaddressed.

To close that gap, the International Sleep Products Association (ISPA)—the trade association for the mattress industry—approached NIST about laying the groundwork for a new mattress flammability standard that would eliminate, or at least greatly reduce, the casualties from bed fires.

Gann and his colleagues leapt at the opportunity and set out to devise a realistic and practical way for manufacturers to test mattress

flammability.

Since bed fires typically start with the ignition of blankets, sheets and other bedclothing items, the researchers aimed to replicate the danger they posed to mattresses. Gann and his team assembled several sets of bedclothes, set them ablaze and gauged the heat release rate (HRR)—an indicator of how intensely something burns, measured in watts—of each.

They used the HRR data to create a special test apparatus composed of twin propane burners that could mimic fires generated by an off-the-shelf set of bedclothes. With the burners, manufacturers could test their mattresses against conditions similar to real-world bedroom fires.

While the researchers developed this new test method, manufacturers experimented with fire-resistant fabrics—such as those used in firefighter uniforms—and implemented them into prototypes to lower their HRR.

But how much lower would the HRR of a mattress need to be? The limit had to be low enough to ensure that burning mattresses would not spark a "flashover," wherein a fire makes a room so hot that all other combustible items in it—chairs, clothes, etc.—suddenly and simultaneously ignite, Gann said.

To find the limit, they measured how much heat it would take to ignite small pieces of material, each representing an item commonly found in bedrooms, such as wooden furniture or softer items like upholstery or curtains. The researchers then burned both prototype and commercially available mattresses, measuring the flow of heat to several spots around the room.

With the two data sets, the team discovered that mattresses with a peak HRR of about 600 kilowatts (kW) or more would produce enough heat

to reliably ignite soft materials almost anywhere in an ordinary bedroom. While the commercial king- and twin-sized beds they tested had peak HRRs far above this value, one prototype fared much better.

"The manufacturers made some prototypes and they worked. When they sent them here, we tested them," Gann said. "Four megawatts. One megawatt. And then down to 400 kilowatts for a king-size bed. In the world of fire safety, that's a game changer."

When mattresses burn below 400 kW, the odds of flashover decrease substantially, the researchers found. To prevent mattresses from coming close to this threshold, the CPSC's standard requires that mattresses maintain an HRR under 200 kW after being ignited by the burning-bedclothes-simulating burners.

By the time the standard became effective on July 1, 2007, mattresses that met the new requirements were widely available. But did this change actually translate into lives saved? If so, how many lives was it saving? Gann was eager to know, but when he set out two years later to find the answers, he learned that there was a colossal roadblock in the way.

Mattresses remain with their original owners for 10 to 12 years on average. And after that, they are often passed on to children or get refurbished and find a new life back on the market, Gann said. This meant it would take years before enough standard-compliant mattresses found their way into homes. With so little data available at the time, Gann had to wait this one out.

Returning to the issue 10 years later, now with a wealth of information available about fire incidents (fires, injuries and deaths) from the National Fire Incident Reporting System and mattress sales from ISPA, Gann brought aboard NIST economists Stanley Gilbert and Dave Butry, who have developed statistical methods to finally put numbers to the

standard's effects.

One of their approaches was to compare the total number of incidents caused by bed fires in 2005 and 2006 combined to the number in 2015 and 2016. They didn't just look at the raw values, though. If other fire-influencing factors—like the number of homes with smoke alarms—were not identical between the two time periods, the comparison could be unfair.

To isolate the effect of the standard from other factors, Gilbert and Butry compared the outcomes of bed fires to upholstered furniture fires, as the combustible materials in both types of fires are similar. Because the standard is exclusively about mattresses, any spike or dip that only appeared in the bed fire numbers, but not upholstered furniture fires, would probably have been driven by the standard.

The researchers crunched the numbers and were pleased to identify several strong indicators suggesting that the standard was doing its job and doing it well. They found that, relative to upholstered furniture fires, the number of bed fires from 2015 and 2016 combined was 12% lower than in 2005 and 2006. In those 10 years, injuries decreased by 34% and, much to the delight of the researchers, deaths plummeted by 82%.

Evidence mounted further in support of the standard as the researchers examined the mattress sales data alongside fire incidents.

The researchers used the sales data to create mathematical models that could estimate how many pre-standard mattresses were being replaced with new ones. The models point to the standard as the likely source of the benefits, as the mattress replacements and reductions in casualties closely mirrored each other throughout the years.

"We used several different approaches to look at the data, and they all

pointed to the same conclusion; the standard saves lives," Gilbert said.

Ryan Trainer, president of ISPA, which was involved in developing and implementing 16 CFR Part 1633, also voiced appreciation that the standard has borne fruit.

"The mattress industry has collaborated with NIST and CPSC to develop a standard that is based on sound science, reflects real world risks, improves safety and is practical for manufacturers to adopt," Trainer said. "We are gratified that NIST's analysis of national fire statistics shows that since Part 1633 was implemented, the number of bed fires ignited by open-flame heat sources, and especially the deaths and injuries from those fires, have dropped so significantly."

More information: Stanley W. Gilbert et al, Estimating the impact of the mattress fire safety Standard 16 CFR Part 1633 on bed fire outcomes, *Fire and Materials* (2020). [DOI: 10.1002/fam.2932](https://doi.org/10.1002/fam.2932)

Provided by National Institute of Standards and Technology

Citation: Mattress flammability standard is a lifesaver, NIST report finds (2020, November 18) retrieved 11 May 2024 from <https://phys.org/news/2020-11-mattress-flammability-standard-lifesaver-nist.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.