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## Study raises concerns over Tasers' safety

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A study measuring electric shocks from a Taser stun gun found that it was 39 times more powerful than the manufacturer claimed, raising new questions about the weapon's safety.

The study, published last month in the peer-reviewed *Journal of the National Academy of Forensic Engineers*, concluded that the shocks are powerful enough to cause fatal heart rhythms. It is one of the few scientific studies of Taser's electric jolt in which the company did not participate.

"The findings show the energy delivered by the weapon to be considerably understated by the manufacturer," the *Journal* study said. "These findings place the weapon well into the lethal category."

Officials with Scottsdale-based Taser International Inc. condemned the findings, saying they are exaggerated, erroneous and "beyond the laws of physics."

They pointed to a test conducted last week in response to the *Journal* article. A lab hired by Taser found that the weapon produced power that was significantly less than what the *Journal* study found and met all specifications.

Taser contends that the author of the *Journal* study, electrical engineer James Ruggieri, does not have the technical expertise to make conclusions about stun guns. Taser is suing Ruggieri for defamation over his claims in a presentation and testimony in a wrongful-death case last year that Tasers can cause fatal heart rhythms.

In a separate finding, the Army also concluded last year that Tasers could cause ventricular fibrillation, the irregular heart rhythm characteristic of a heart attack.

A memorandum from the Aberdeen Proving Grounds in Maryland, where the Army develops, tests and evaluates weapons, said, "Seizures and ventricular fibrillation can be induced by the electric current."

At issue was whether soldiers should be shocked with the stun guns during training

exercises, as Taser recommends.

The Army's occupational health sciences director determined that Taser is an effective weapon but added in the February 2005 memo that "the practice of using these weapons on U.S. Army military and civilian forces in training is not recommended, given the potential risks."

Taser for years has maintained that its stun guns have never caused a death or serious injury. Company officials say the guns save lives, reduce injury and save millions of dollars in legal costs because they prevent deadly confrontations.

But since 1999, more than 167 people have died after police Taser strikes in the United States and Canada. Of those, medical examiners have cited Tasers in 27 deaths, saying that they were a cause of death in five cases, a contributing factor in 17 cases and could not be ruled out in five cases.

Several law enforcement agencies have filed lawsuits accusing Taser of misleading them about the stun gun's safety and claim that the company failed to conduct adequate tests before selling the weapon. Some police departments have delayed or halted Taser purchases because of safety concerns.

Taser denies these claims and says its record of safety is bolstered by dozens of medical and university studies and by the company's experts.

Law enforcement officials and testing experts agree that there is no widely accepted standard for measuring Tasers. Studies have shown various results.

In May, for example, an international testing laboratory hired by Canadian authorities initially reported that two stun guns were significantly more powerful than the manufacturer specified. The guns also fired at different levels of power.

The stun guns were used on a man who died after being shocked by Vancouver, British Columbia, police in 2004.

Taser challenged the test last week, and the laboratory backed off its results. Officials with the lab, Intertek ETL Semko, said testing protocols provided by the police differed from those of the stun-gun manufacturer. As a result, Intertek said the tests could not be relied upon.

Bruce Brown, deputy commissioner of a British Columbia agency investigating the police role in the Vancouver death, said his agency wants to enlist Canada's National Police Research Center to conduct a rigorous study of the stun gun's power.

"We've sent people to the moon, so there has got to be a way to come up with a peer-reviewed (standard)," he said.

The 50,000-volt Taser works by shooting two darts up to 25 feet. The darts are connected to wires that deliver a burst of electricity that is designed to instantly immobilize a suspect. The gun also can be used as a handheld device, without the darts, by touching two metal probes directly against a person's body in what police call a "drive stun."

The shock from a Taser is measured in electric pulses. Tasers typically used by police deliver 15 to 19 pulses a second in a five-second interval, although the gun will continue firing without interruption as long as the trigger is held down.

Tasers operate at 50,000 volts, but Taser says the stun guns do not pose an electrical safety risk because the pulse's current is too low and its duration too short to affect internal organs, including the heart.

Ruggieri's study found that the Taser's pulse was more powerful and longer than the gun's specifications indicate. Ruggieri studied a Taser M-18, which is nearly identical to the Taser M-26 used by police except it has less power.

Taser specifies that the M-18 produces 10 pulses a second at 1.76 watts per pulse. Ruggieri said his tests showed the Taser produced 14 pulses a second at 50 watts per pulse.

Ruggieri said it took him months of research to conduct and complete the tests.

He said he relied on Taser's research and previous stun-gun studies to create a verifiable methodology for testing the Taser.

His findings are based on how electric current penetrates the body. When established electrical standards were applied to the stun gun's electrical discharge, Ruggieri said the current could be fatal. He said measurements of the electric current showed that, according to electric safety standards, the gun had a 50 percent risk of causing ventricular fibrillation.

Taser Vice President Steve Tuttle called the claim "ludicrous" and said it is "clearly refuted by the fact that well over 100,000 human volunteers have been exposed to the Taser discharge without fatality."

Taser maintains that skin tissue blocks electric current and is equivalent to 1,000 ohms of resistance.

But Ruggieri said skin tissue breaks down as electricity is applied, decreasing resistance and increasing the impact of the shocks on the human body.

"This creates a runaway effect of increasing current with decreasing resistance," Ruggieri said.

An independent electrical engineer who reviewed the *Journal* study at the request of *The Arizona Republic* said Ruggieri's conclusions were credible and based on scientific principles.

Robert Nabours, who has degrees in electrical engineering from Stanford and the University of Arizona, said scientific and medical evidence support Ruggieri's claims that skin tissue breaks down when subjected to electric pulses. Among the evidence are findings from Harvard and Massachusetts Institute of Technology doctors.

Ruggieri focused on the Taser in its "drive stun" mode. He said measurements of the current found that the power was about 39 times greater than the manufacturer's specifications. Taking into account the lowered resistance of skin

tissue, Ruggieri said the stun gun generated 704 watts of power as opposed to 18 watts.

Ruggieri contends that one of Taser's main claims of safety, that the duration of the electric pulse is too short to cause injury, could not be proven. He said his tests of the current showed that duration of the pulse also increases as resistance drops.

The lab hired by Taser, Exponent of Phoenix, could not replicate Ruggieri's results. Exponent, which has offices throughout the country, is a consulting firm that employs scientific and engineering experts who, like members of the National Academy of Forensic Engineers, often serve as expert witnesses in court cases.

Exponent electrical engineer Ashish Arora said Ruggieri reported 17 times more power than the Taser he tested. Arora said that in his tests, the power of the stun gun measured at or below specifications.

Arora said the pulses Ruggieri measured could also not be verified, even when resistance was dropped. He said that caused concern.

He said he would have expected some similarity in the results. But he said the tests results "were completely different."

There were differences between Exponent's and Ruggieri's tests, both involving how the gun was charged and how the current was measured.

Ruggieri said he used a battery specified by the manufacturer to mirror a real-world setting. He changed the battery after each jolt to ensure that the power did not degenerate. Exponent used a power supply to charge the battery.

Ruggieri said a power source could limit the amount of power going into the gun in a way that a battery would not.

Ruggieri also measured the output using two high-voltage meters attached to each of the Taser probes, which he said gave more-accurate readings.

Exponent used a single meter. Arora said the single probe and battery wouldn't change the results.

Taser has repeatedly attacked Ruggieri's credibility since he made a presentation critical of the stun guns to the American Academy of Forensic Sciences in February 2005. Taser claimed his presentation was based on "junk science" and "propaganda" and that his conclusions have been disputed by numerous government, university and medical studies.

Some of Ruggieri's claims were independently verified, including his assertion that Taser had misapplied Underwriters Laboratories standards in suggesting the stun gun could not cause ventricular fibrillation.

Taser sued Ruggieri in November, several months after he announced the *Journal* findings at an engineering conference in Chicago.

In a news release last year, Taser described Ruggieri as a high school dropout with no medical training.

Ruggieri said he left high school to attend college in New York. He later obtained a master's degree in computer science from the University of Phoenix.

Ruggieri's resume shows that he is a professional engineer with licenses in five states. He said he has investigated electrical accidents for federal agencies and helped write electrical safety standards for top electrical laboratories and commissions.

Taser officials challenged the academy journal, calling it an "obscure bulletin," saying none of the peer reviewers was qualified to assess the findings.

"That unfortunately allowed Mr. Ruggieri to utilize inappropriate science and flawed mathematics in attempts to support his unsupportable conclusions," Taser's Tuttle said.

*Journal* Editor Marvin Specter said the academy is affiliated with the National Society of Professional Engineers and is made up of experts in several engineering disciplines.

*The Journal* lists a technical review committee for Ruggieri's study that includes 20 engineers, including one well-known Taser consultant. The reviewers' identities are confidential and have not been released, Specter said.

Specter said Ruggieri's paper went through a rigorous peer-review process before being published in the biannual journal.

In an interview last week, Ruggieri said Taser has launched personal attacks to distract from the real issue.

"This isn't about me. It's about the findings, the study," he said.

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