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# The problem of unexploded bombs

**Unexploded ordnance from World War II comes to light in Germany on a fairly regular basis. Defusing these devices is a hugely difficult—and sometimes deadly—task. Experts hope that an automatic laser system could make this job safer and easier in the future.**

Clank! The excavator's shovel has struck metal – and what initially looked like a rusty boiler is, in fact, an unexploded bomb. One false move and it could bring entire apartment blocks tumbling to the ground. Shards of window glass could be thrown thousands of meters, creating lethal projectiles. The authorities move into action. The police evacuate everyone within a 12-kilometer radius – emptying hospitals, retirement homes, penitentiaries and rail stations – and the bomb disposal team arrives at the scene and attempts to eliminate the danger as best they can. All this happens several times a year in Germany as a result of some 1.6 million tons of explosives that were dropped on German cities in World War II by British and American bombers. Some 60,000 tons of unexploded ordnance remains buried beneath densely populated areas, and old bombs are unearthed on a regular basis.

Disarming these devices is becoming increasingly difficult. After 80 years in the ground, the old explosives and detonators have typically deteriorated to a degree that makes them highly unpredictable. But now a team of researchers led by project manager Christian Hoff at Laser Zentrum Hannover e.V. (LZH) is developing a new method of rendering unexploded bombs safe. Their approach relies on leaving the detonator alone and attempting instead to weaken the bomb casing. They then aim to interrupt the ignition chain by means of a targeted deflagration. Experts say that the thickness of the bomb casing is a major factor in determining the maximum possible explosion pressure. If the bomb casing immediately yields to the explosive charge then, instead of a gigantic boom, you get a comparatively harmless type of explosion.
There is no way of safely opening the casing of a live bomb using mechanical tools. Transporting the tools to the site is difficult or impossible, and they generate too much heat and vibration as they open up the casing.

Using laser light, however, it is possible to ablate a grooved "notch" in the 10 to 25-millimeter thick casing without touching it. The amount of heat applied in this process can be controlled as long as the molten material is kept well away from the explosive charge. The bomb disposal team could then use this predetermined breaking point to carry out a deflagration at subsonic speed, converting only part of the explosive material in the process. Although the pressure wave would be lower, it would still be sufficient to "pop out" the detonator backwards, rendering the bomb safe.

The LZH engineers have already succeeded in significantly weakening bomb casings using their laser system in the lab. Their goal now is to complete the project by 2019 and unveil a mobile, automated system. This would make the hazardous job of bomb disposal substantially safer in the future.

## Christian Hoff

Christian Hoff, Head of Additive Manufacturing – Metals at Laser Zentrum Hannover e.V., is in charge of the laser-based deflagration project. This method could offer a safe way to disarm unexploded ordnance in war zones.



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