

## Press Release

Why tuning up a pedelec can have devastating consequences

### **Dangerous strain, especially for brakes**

- ▶ Components are built for speeds according to regulations
- ▶ Overheated brake discs change their properties
- ▶ First gradual deterioration, then often life-threatening total failure

**Pedelecs are on the rise. In Germany, for example, in 2023, for the first time, more than every second bike sold was equipped with electric assistance. The fact that the motor only works up to a certain speed seems to bother many owners – they turn to tuning kits from the internet. The DEKRA experts issue an urgent warning: the braking systems in particular are often not up to the task. “Many people don’t realize the risks they are taking with tuning”, says David Freibott, accident analyst at DEKRA and expert in manipulated pedelecs.**

Although regulations regarding electric bicycles vary from country to country, they usually have one thing in common: motor support is restricted to a certain speed or motor output – for example to 25 km/h (15.5 mph) in the EU, Australia or India, to 30 km/h (19 mph) in China, to 20 mph (32 km/h) in Canada and many U.S. states, or to 300 W in New Zealand – in order for the pedelec to be regarded as a bicycle. This means that usually no registration, insurance, or driver’s license is required.

Components like frames or brakes are built for these respective speeds and power outputs. Changing these parameters by using a tuning kit – which provides motor assistance above and beyond the original threshold and leads to higher average speeds – can therefore have devastating consequences. “It is not without reason that, in Germany, for example, so-called S-pedelecs, which provide electric assistance up to 45 km/h, not only need insurance but also more than the manufacturer’s declaration of conformity to be approved for road use”, says David Freibott. “An independent test procedure is required, including examination of the construction and function of the brake system.”

The expert often finds completely overstrained brake systems on manipulated pedelecs, especially on the rear wheels. “Of course, an ordinary pedelec disc brake can decelerate the bike from 40 km/h at a traffic light. It can also perform safe braking

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Contact Wolfgang Sigloch  
Phone +49.711.7861-2386  
Fax +49.711.7861-742386  
E-Mail wolfgang.sigloch@dekra.com

DEKRA e.V.  
Corporate Communications  
Handwerkstraße 15  
70565 Stuttgart, Germany  
[www.dekra.com/en/press-overview](http://www.dekra.com/en/press-overview)

from 60 km/h occasionally. But it can't perform braking from such high speeds all the time", he explains. "That's pure physics."

When braking, speed is reduced by converting kinetic energy into heat. Even seemingly small changes can make a big difference. This is because the kinetic energy does not change linearly as the speed increases, in fact the speed affects the equation squared. This means, that twice as much kinetic energy must be converted into heat when braking from 36 km/h (22 mph) compared to 25 km/h (15.5 mph).

However, if the braking system constantly must convert more heat than it was designed for, this leads to severe consequences: "Once a braking system is overheated, it is permanently damaged. Initially, the braking effect gradually diminishes, which is difficult for the rider to recognize. In the worst case, however, continued use without repairing the brakes can lead to total failure, which is often life-threatening", says the accident expert.

### **Scientific project by DEKRA Accident Research**

Overheating often changes the material properties of the brake discs. A recent scientific project by DEKRA Accident Research shows what this means: Among other things, different brake tests were carried out on the expert organization's pedelec test bench – with an untuned bike and a tuned-up vehicle as well as with new brake discs and once thermally overloaded brake discs on the rear brake. Ten standard brake maneuvers were carried out in succession for each series of tests. The pedelec was going at a speed of 25 km/h (15.5 mph) in its original condition, and 39 km/h (24 mph) in the tuned-up version – the average maximum speed of more than 120 manipulated vehicles that David Freibott had examined in analytical reports.

"Our tests in the lab showed that although deceleration with the overheated brake discs was still present, it was noticeably reduced and the braking force was also measurably uneven", summarizes the expert. In addition, the tests with the tuned-up pedelec showed that the system reached significantly higher temperatures overall – not surprising given the higher speeds. "Overheating leads to a vicious circle: the heat-damaged discs can no longer absorb the heat and, above all, can no longer release it into the environment as quickly as they should. As a result, the entire system overheats more frequently in further usage, which sooner or later leads to catastrophic consequences."

The altered material properties of the thermally overloaded brake discs were also confirmed by a metallurgical analysis. This material change could increase the tendency for the formation of cracks.

## Frames and other parts can also be overstrained

However, it is not only the brake system of a pedelec that is usually overstrained after tuning. The bicycle frame as well as other parts are also designed to withstand certain loads. With a modified pedelec, the maximum force is exerted by the motor for longer, the frame is subjected to greater stress; higher speed over uneven ground means more vibration. "All of this can ultimately lead to a fatigue fracture, for example on the frame in the chain stay area, on the handlebars or on the seat post. There's no need to explain the consequences this can have while riding", says the DEKRA expert. He advises everybody to only use their electric bicycles as intended by the manufacturers. "Anything else all too easily becomes a lottery for your own safety."

### Picture captions

DEKRA Pedelec: Electrically assisted bicycles or pedelecs are becoming increasingly popular. DEKRA experts issue an urgent warning against attempts to use tuning kits to provide pedal assistance at higher speeds: the brake systems in particular are not designed for this.

Overheated: Overheating changes the material properties of brake discs. Initially, the braking effect gradually diminishes. With continued use, the worst-case scenario is a life-threatening total failure of the brakes.

### About DEKRA

*DEKRA was originally founded in 1925 to ensure road safety through vehicle inspection. With a much wider scope today, DEKRA is the world's largest independent non-listed expert organization in the testing, inspection, and certification sector. As a global provider of comprehensive services and solutions, we help our customers improve their safety, security, and sustainability outcomes. In 2022, DEKRA generated sales totaling nearly EUR 3.8 billion. The company currently employs almost 50,000 people who offer qualified and independent expert services in approximately 60 countries on five continents. With a platinum rating from EcoVadis, DEKRA is now in the top one percent of sustainable businesses ranked.*