# Press Release

## Stainless Steel Brake Discs Significantly Reduce Fine Particulate Emissions and Offer Exceptional Durability

**Until now, fine particulate matter generated by tire and brake wear has not been addressed in European emissions legislation. Only with the introduction of the Euro 7 standard – taking effect at the end of 2026 for newly developed (type-approved) vehicles and at the end of 2027 for all newly registered passenger cars and light commercial vehicles – will binding limit values be introduced. The goal is to restrict the emission of fine particulate matter with diameters less than 10 micrometers, particles that can penetrate deep into the respiratory tract and are considered particularly harmful to human health. A project consortium involving Fraunhofer IWU has now introduced a stainless-steel brake disc that easily meets the strict EU requirements.**

The brake disc, manufactured using forming processes, exhibits extremely low wear and has a projected service life of up to 300,000 km. When used in a wheel brake system with an inorganic friction material, wear is reduced by more than 85 percent compared to today's standard solution, consisting of a gray cast iron brake disc and an organic friction lining.

### Why Corrosion-Resistant, Hardened (Nitrided) Stainless Steel Is Particularly Suitable

At an early stage, the project team opted for nitrided stainless steel, which is particularly well-suited due to its tribological and thermal properties. A positive experience with stainless-steel brake discs on motorcycles also supports this choice. Specialized solutions such as carbon–ceramic brakes are only feasible for very high-end vehicles, while coating gray cast iron is extremely challenging – laser cladding methods are not yet ready for series production. Structural steel discs, on the other hand, do not meet the requirements for dimensional stability at temperatures above 650 °C; phase transformations occurring in this temperature range can also adversely affect the material properties.

### Forming-Based Manufacturing and Weight Advantages

The project team produced brake discs with a slightly larger diameter than conventional gray cast iron discs in order to provide sufficient surface area for the required deceleration performance (braking force). In return, the thickness of a steel brake disc can be reduced. Since the starting material is initially available in a square format, cutting scrap is generated, but this material can be remelted. Depending on the vehicle, a set of four stainless-steel brake discs can be up to 5 kg lighter than comparable brake discs made of gray cast iron. The

reduced weight not only lowers the vehicle's energy consumption but also decreases unsprung mass. This allows the suspension and dampers to operate more efficiently, improving vertical dynamics and overall driving behavior.

## Option for a Lifetime Brake System and a Positive Cost Balance

The manufacturing costs of gray cast iron brake discs appear low only as long as there are no statutory requirements for fine particulate emissions caused by brake wear. With the introduction of the Euro 7 standard, however, only 3 mg/km for battery-electric vehicles and 7 mg/km for all other powertrain types will be permitted for passenger cars and light commercial vehicles with up to 3.5 tons gross vehicle weight. Conventional wheel brake systems generally fail to meet these limits – even when combined with high-quality brake pads. But even without the regulatory requirements of Euro 7, their overall cost balance over a vehicle lifetime of up to 300,000 km becomes unfavorable. Once the wear limit is reached, they must be replaced (often together with the brake pads), with labor costs frequently accounting for the largest share of total expenses. Replacement may be necessary after less than 40,000 km, if long idle periods combined with road salt (corrosion), short-distance driving, or a sporty driving style (increased wear and grooving) accelerate degradation.

## Initial Tests Successfully Completed

The stainless-steel brake disc developed by Fraunhofer IWU in cooperation with the Chair of Vehicle System Design at TU Chemnitz, ElringKlinger AG, and ANDRITZ AWEBA GmbH has already been successfully tested on the inertia dynamometer at TU Chemnitz. The brake disc passed testing in accordance with SAE J2522 (AK Master). The tests demonstrated excellent tribological performance. The system – consisting of a stainless-steel brake disc and inorganic friction material – showed approximately 85 percent less wear compared to solutions currently available on the market.

## Project partners

The automotive supplier **ElringKlinger AG** contributed its process expertise in coating technologies and its materials know-how in metal processing to the "Ufo-Brems" project. **ANDRITZ AWEBA GmbH** is a full-range supplier in the tooling sector, covering forming, cutting, and die-casting tools from development to series readiness. **The Chair of Vehicle System Design at TU Chemnitz** provided its testing infrastructure and was responsible for the brake disc design. **Fraunhofer IWU**'s roots lie, among other areas, in forming technology and, in this context, carried out the accompanying finite element (FE) simulation as well as the experimental implementation of the forming stages for the brake disc.

The "Ufo-Brems" project was funded by the German Federal Ministry for Economic Affairs and Energy and coordinated by Projektträger Jülich.

Supported by:

Federal Ministry for Economic Affairs and Energy

on the basis of a decision by the German Bundestag

projektträger jülich

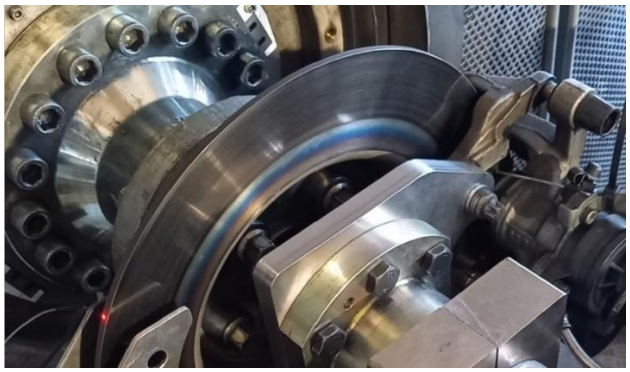

**Fig. 1 Stainless-steel brake disc in a fading test: no reduction in braking performance even after 15 brake applications. © TU Chemnitz**

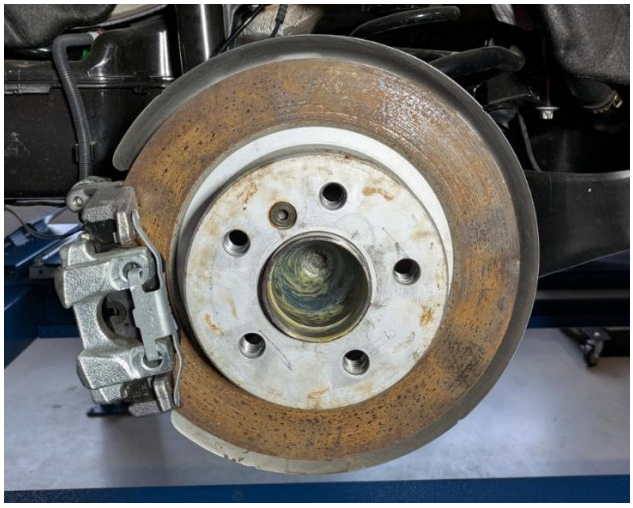

**Fig. 2 Severe corrosion and scoring: gray cast iron brake disc that would no longer pass a mandatory vehicle inspection. Safe continued operation of the vehicle is no longer possible with this wear pattern on the brake disc. © Fraunhofer IWU**

The **Fraunhofer Institute for Machine Tools and Forming Technology IWU** is an innovation-driven partner for research and development in production engineering. Over 600 highly qualified employees work at our locations in Chemnitz, Cottbus, Dresden, Leipzig, Wolfsburg, and Zittau. We unlock potential for competitive manufacturing, across industries like automotive, aerospace, electrical engineering, and precision engineering. Our research and contract research encompass the entire manufacturing ecosystem, from individual components to processes, methods, complex machine systems and human interaction. As one of the leading institutes for resource-efficient manufacturing, we bank on highly flexible, scalable cognitive production systems using nature as an example. We take a holistic approach to the entire process chain, aligning with circular economy principles. We develop technologies and intelligent production plants and optimize forming, cutting, and joining manufacturing steps. Our services include innovative lightweight structures and technologies for processing new materials, functional transfer to assembly groups, and the latest technologies of additive manufacturing (3D printing). We provide solutions for climate-neutral factory operations and large-scale production of hydrogen systems, thus paving the way for the transition to renewable energies.

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