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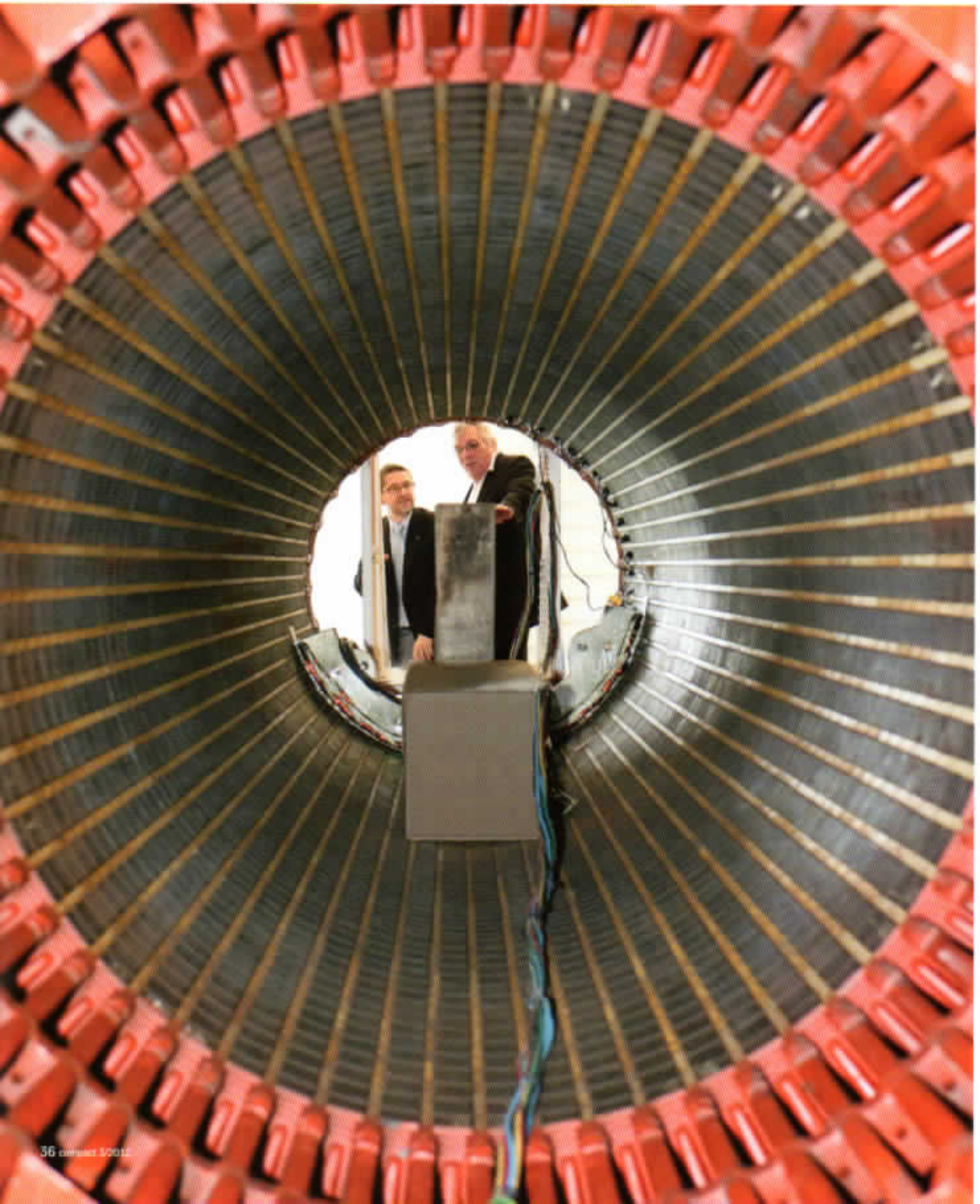
ThyssenKrupp Steel Europe
Thinking the future of steel

ThyssenKrupp

Research cooperation on electrical steel
Better, cooler, quieter

Reducing core loss and noise levels is the focus of research by Dr. Thierry Belgrand (left) and Prof. Jean-François Brudny.



Research collaboration in France seeks to further optimize electrical steel.

Our modern societies are highly electrified. But also in the booming countries such as Chile, India and South Africa, the demand for energy is enormous – and still growing. Wherever energy is produced, converted, transported, distributed or consumed electrical steel is involved. But the demands placed on the material are increasing all over the world. Accordingly, ThyssenKrupp Electrical Steel is pushing ahead with optimizing electrical steel strip – and beyond standardized dimensions, as shown by research collaboration in France.

"Although our electrical steel already achieves an efficiency of more than 99 percent, we are pushing ahead with its development," explains Dr. Thierry Belgrand, Head of Research and Development (R&D) at ThyssenKrupp Electrical Steel UGO in Isbergues. Better, cooler and quieter – these are the targets for the grain oriented electrical steel that is produced there. This is what the French subsidiary has been researching, in collaboration with the Université d'Artois in Béthune since 2006 – or to be more precise with the Laboratoire Systèmes Electrotechniques et Environnement (LSEE) at the university in northern France, which specializes in electrical engineering.

"Two of the challenges that we are currently addressing in our scientific research are reducing the core losses and noise levels. And our customers need answers to both in the short term," Belgrand continues. Prof. Jean-François Brudny, Head of the LSEE, adds: "These are major topics that still raise fundamental issues despite decades of research into electrical steel." Some results follow: the transformer is one typical application for grain oriented electrical steel. Core losses that cause heat arise in the transmission and distribution of energy. This in turn implies that energy is lost in the transformation process. Another phenomenon: the many sheet metal laminations in the transformer can vibrate. This movement causes a noise – a low-frequency hum, in which both groups of researchers are particularly interested. "Up to 350 tonnes of electrical steel are used as iron core material in a single machine transformer at a power plant. This generates a fairly strong noise. But also mid-range and small transformers make a noise which is perceived as a nuisance – especially when they are attached to homes and in residential neighborhoods," explains Belgrand, who has been working for ThyssenKrupp Electrical Steel in northern France since 2007. In many places there are regulations to reduce this hum – like in the European Union, for example. Research on noise generation has been in progress since the 1950s. "And we are in the processing of clarifying what the driving force behind the phenomenon is," Brudny emphasizes.

To understand these two phenomena, Belgrand and Brudny, whose international team comprises 15 lecturers, an equivalent number of PhD students, and two post-doctoral students, are examining the complex processes within a transformer. Their approach is highly original: among other things, they decided to build core models. These three-phase models based on real 630-kVA transformers consist of 300 kg PowerCore® electrical steel by ThyssenKrupp Electrical Steel. After years of research, the following is now known: The thinner the sheet, the lower the core loss. "And thanks to cooperation with the LSEE, we were able to confirm our long-held suspicions: Vibration occurs primarily at the corners of the transformer core – caused by the forces between the laminations, which in turn are generated by the change in the magnetic field," says Belgrand, explaining part of the results. Additionally, there is no one-to-one relationship between core loss and noise. Instead, the insulating coating of the steel and the design of the transformer decide whether it is quiet or loud. And: "An optimized laser for processing the outer coating of the electrical steel reduces noise by up to three decibels," Belgrand adds.

But the research group is not only taking an original look at transformers. "We also have investigated the use of grain oriented electrical steel in electronic machines," says Belgrand. Grain oriented electrical steel is not typically used in rotors and generators. The provisional results: "In tests on machines with a frequency of up 50 hertz, we achieved an efficiency increase of three percent, which is a considerable value," says Brudny, who has access to electrical machines such as a full-scale, 125 megawatt turbo-generator in the laboratory, pointing to the enormous energy savings. "At the same time, we determined a reduction in noise." This welcome finding is about to be tested on larger machines.

From research to applications: The results will be used throughout ThyssenKrupp Electrical Steel. The R&D teams in France and in Germany under the direction of Dr. Ludger Lahn are currently following them up. Findings from research collaboration do not only flow into customer service, but also into production: "We offer thinner grades and have optimized our laser," said Belgrand. All of these steps are geared to meeting the most demanding requirements of our international customers.

Dr. Dana Szygalski

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