Sonderdruck

Turns into motion
Electrical Steel from ThyssenKrupp Electrical Steel

A company of ThyssenKrupp Steel

ThyssenKrupp Electrical Steel

ThyssenKrupp

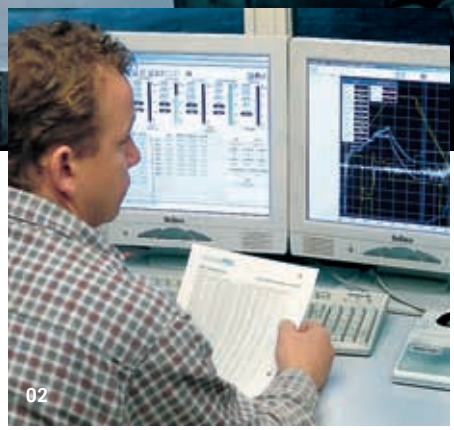
Cover photo | Wherever energy is generated, transformed, distributed or consumed, you can be sure grain-oriented ThyssenKrupp Electrical Steel PowerCore isn't far away. Based on a unique crystallographic texture, the material has special magnetic properties, which lend it the strength it needs to perform its tasks. The secret - the clearly visible grains - is no secret to Nadine Polhöfer, Sales Management Assistant. Turn to the following pages to find out how the grains become arranged in a particular direction and to learn about the journey electrical steel undergoes before it helps make electricity flow.

Treasury I The finished goods store at Gelsenkirchen, where our high tech electrical steel embarks on its journey to the customer. The product range starts at conventional 0.35 millimetre thick PowerCore C and goes right through to 0.23 millimetre thin, energy-saving PowerCore H, depending on the customer's requirements. The finished transformer is, however, still a long way off. Photo: **Rainer Schröer**

THYSSENKRUPP ELECTRICAL STEEL

PowerCore® turns into motion

Wherever energy is generated, transformed, distributed or consumed, you can be sure electrical steel isn't far away. Based on a unique crystallographic texture, the material has special magnetic properties, which lend it the strength it needs to perform its tasks. Grain-oriented electrical steel, for example, plays an important role in the production of energy-efficient transformers and large power generators. The following pages describe the journey ThyssenKrupp Electrical Steel PowerCore takes before, as one component in a complex chain, it helps ensure that electricity flows from the mains sockets in our homes at exactly the right voltage.



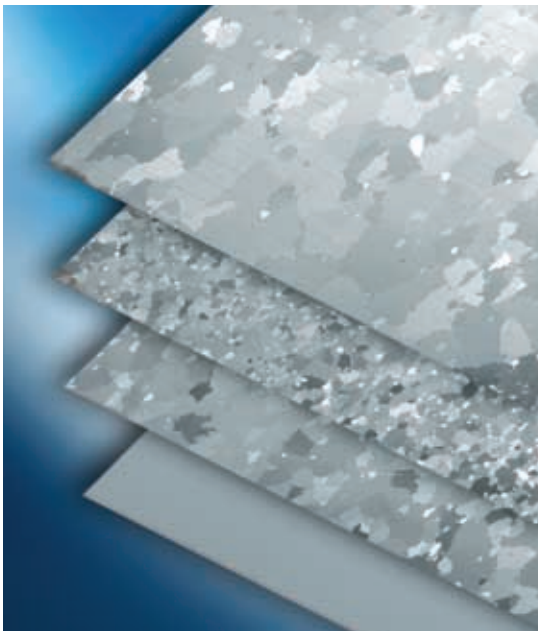
How does steel become electrical steel? The raw material, hot-rolled strip produced according to precise specifications, comes from ThyssenKrupp Stahl in Duisburg. Once it arrives at ThyssenKrupp Electrical Steel, it is trimmed on a build-up line, then processed on a combined hot-strip annealing and pickling line and cold-rolled to the desired thickness. A decarburisation annealing line then reduces the strip's carbon content in order to improve its magnetic properties.

High temperatures - large grains

Only then starts that production process that turns the strip into electrical steel. During a high-temperature box-annealing process, where the coiled strip is annealed for five to seven days at up to 1,200°C, a special texture, clearly visible to the naked eye, is developed in the material by selectively growing large grains. Incidentally, it is the orientation of these grains in a specific direction which distinguishes grain-oriented Power-

01 Annealing I Coiled strip is annealed at up to 1,200°C in ThyssenKrupp Electrical Steel's box furnaces in Gelsenkirchen for five to seven days - the end result is electrical steel. The extreme heat causes large grains to grow in the material in a particular direction, minimising any restriction of the magnetic flux. The PowerCore in a large power transformer will convert more than 99% of the energy fed into the transformer.

02 Monitoring I The high-temperature box-annealing process is monitored around the clock from the control room. Karl-Heinz Schneider, Senior Annealer in the High-Temperature Annealing team, leaves nothing to chance in this crucial production phase.
Photos: **Rainer Schröer**



Secret | The magic of electrical steel lies in its texture - that's what gives it its magnetic properties.

Core from non-grain-oriented electrical steel and gives the former its special magnetic properties in the rolling direction.

So the secret is in the grains - they minimise any restriction of the magnetic flux. The grain-oriented electrical sheet in a large power transformer will convert more than 99% of the energy fed into the transformer.

Three days of cooling, insulative coating, laser treatment where required, trimming and slitting, and then the high tech product is finished and ready to be sent on its journey to the customer.

PowerCore® layer for layer

The product range starts at conventional 0.35 millimetre thick PowerCore C and goes right through to 0.23 millimetre thin, energy-saving PowerCore H, depending on the requirements. In order to build a transformer, the electrical steel is cut into various shapes on state-of-the-art slitting lines. Finally, the cut pieces are stacked on top of each other in the shape of a large E to create a transformer core. The stacks are then turned upright, a copper coil is wrapped around them and an electrical-steel girder is placed across the top.

From battery chargers to wind turbines

ThyssenKrupp Electrical Steel's grain oriented products are used in large power transformers, distribution transformers and small transformers. So grain oriented PowerCore can be found wherever electrical energy is transformed and distributed - from battery chargers to trains, aeroplanes and televisions right through to welding equipment and dryers. To guarantee the electricity transformation in an optimum way, it transforms energy into the necessary form - with a high voltage and low current. And it does so using as little energy as possible. Low-loss electrical steel ensures that today's large power transformers have efficiency ratings of over 99%.

One large power transformer can contain between 50 and 350 tons of electrical steel. “Our PowerCore is a green product”, says Werner Auerswald, who is responsible for marketing at ThyssenKrupp Electrical Steel. “Not only does it save energy, it is also used in alternative electricity generation. For instance, a wind turbine contains 1.5 to 7.5 tons of the product.” However, the type used in such applications is non-grain-oriented electrical steel from ThyssenKrupp Stahl’s range of PowerCore brand products. “In the future, PowerCore electrical steel will also be used in car drive systems, keeping things moving.”

Christiane Hoch-Baumann/Katharina Mette

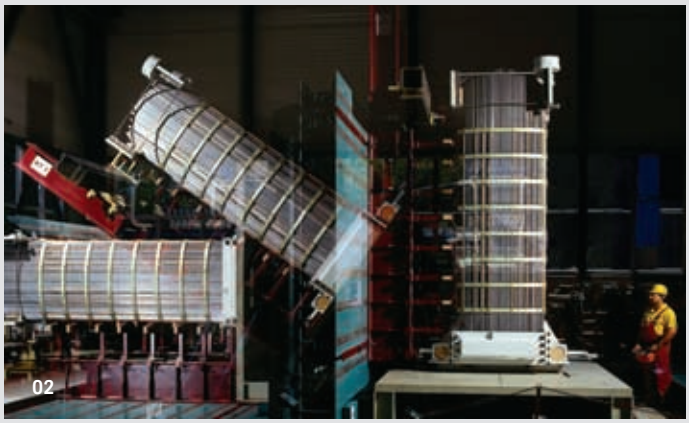
Powerhouse I This transformer, manufactured by Belgian company Pauwels, at the Duisburg-Hamborn power station transforms 332 MVA (megavolt-amperes) of power - enough to supply a medium-sized city. Photos: **Rainer Schröer**

Even more international in the future

ThyssenKrupp Electrical Steel’s headquarters are located in Gelsenkirchen. Grain-oriented electrical steel is shipped from there and from the production facility in the French town of Isbergues to customers all over the world. The company plans to ship around 200,000 tons in the 2004/2005 fiscal year. Just under 1,100 workers are employed at the two sites. “We want to expand our international position even further in the future”, says Executive Board member **Heinz Pafferath** , emphasising the company’s goal. “Our customers demand increasingly higher quality in our products so that they can make the energy conversion in their products even more efficient. And we too strive to help save energy.” Mr Pafferath adds that international knowledge exchange and intensive research and development work will play a fundamental role. “Our international efforts are focused on the Chinese and Indian markets, among others, since they offer interesting market potential for transformers due to their high economic growth.”

International I For Clemens Iller, Executive Board member responsible for Sales at ThyssenKrupp Electrical Steel, the Chinese market is of great interest due to its high economic growth and the potential it holds for transformers.

From electrical steel to a transformer



Grain oriented electrical steel is a complicated material and a vast amount of expertise is required to produce it. But the process of turning the material into a transformer also requires outstanding skill.

Siemens, for example, was purchased with big volumes of grain oriented PowerCore from ThyssenKrupp Electrical Steel in the 2003/2004 fiscal year. The electrical steel is formed on special, state-of-the-art processing lines, where it is first slit and then punched. The sheets are then carefully stacked on top of each other in a particular shape, copper is coiled around the stack, the stack is lifted into an oil-filled vat and then bound to make the finished transformer.

It can take eight months to complete a transformer. The finished product is sold to energy suppliers. ThyssenKrupp Stahl also has its own power plants and that's where we come full circle. Even in Duisburg, the steel company operates more than 1,500 transformers; there are a further 500 in Bochum and 800 in Dortmund.

01 Manual operation I Siemens workers in Dresden carefully assemble the core of a transformer, layer by layer. The electrical steel they use to do so, which is produced by ThyssenKrupp Electrical Steel, is slit on special processing lines and punched into various shapes.

02 Heavy operation I A transformer, made of PowerCore electrical steel and weighing up to 300 tons, being erected at Siemens in Nuremberg.

03 Precise operation I A crane is used to lift the transformer core, which weighs several tons, into the vat at Siemens so that it can then be bound to make the finished transformer.
Photos: **Siemens**

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