compact steel
Issue 02/2016
The steel magazine from thyssenkrupp
thyssenkrupp-steel.com

Development
Organizational changes aim to provide greater flexibility in deliveries of NO electrical steel

Infographic
The automobile has been moving the masses for 130 years

Agenda
Groundbreaking vehicle concepts that are fun

One fits the other

In pilot production the Steel division of thyssenkrupp tests new production processes and materials for practical application

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We would like to further develop our magazine as well as our materials. Please let us know what you think at thyssenkrupp-steel.com/magazine/survey

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Title: thyssenkrupp steel Europe photography Pages 2–3: Photos: Rüdiger Nehmzow, Dominik Asbach, Martin Wagenhan, Julia Urkel Illustration: C3 Visual Lab

Dear readers,

We want the term “tomorrow” from our brand promise to be a positive element of our daily work. You can read in our cover story about how thyssenkrupp‘s steel division is constantly developing new materials such as TRIBOND® – a composite material that consists of three layers, combining high-strength and ductile steels. You can also read about how we are continuously researching new production processes in order to develop more tailored production methods and better system technologies. In our agenda interview, which we held at Aachen University, you can read about the car of the future – how it features a side stick controller instead of a steering wheel and how it allows you to make a turn in a single motion. This innovative product requires innovative materials and modern technologies, which we will use to shape the future.

But there is more: ‘Tomorrow’ also implies being well positioned for the future. We are increasingly putting our customers at the center of our activities and restructuring our organization to this end. This will involve the CEO directorate assuming responsibility for Markets and Sales under the leadership of Andreas Goss. We will soon also divide the technical production areas into two large directorates. I will be responsible for one of them and will continue to be your point of contact in this capacity. You can find more detailed information about the distribution of roles in the News section on page 7. I hope you enjoy reading this future-oriented issue.

Sincerely,
Dr. Heribert R. Fischer
Director of Sales & Innovation

The best of the rest

Slag is a non-metallic, mineral substance that is produced as a by-product when metals are separated from various raw materials. It is always found whenever steel is produced. Slag from steel mills used to be discarded for the most part, but it has become an important raw material for thyssenkrupp, thanks to its constant efforts in the area of research and development. thyssenkrupp prepares and processes slag from steel mills and blast furnaces, turning it into ecological products. It can be used, for example, in road construction, landscaping work, as drainage material in sports fields and riding grounds, as a raw material for asphalt layers, and to create anti-frost layers when constructing roads. Slag products from thyssenkrupp fulfill all relevant environmental guidelines, standards, and technical delivery conditions that are required by respective construction methods. They are perfect substitutes for crushed stones such as diabase, basalt, or graywacke.

The staff of the MillServices unit in the Materials Services Business Area is your point of contact. The department collaborates with Steel to oversee slag management, which covers managing the slag bed, transportation, and processing through to product development, quality control, and customer-oriented marketing.
You can find out more here:
http://www.tkmss.com/EN/

Photo: thyssenkrupp steel Europe photography

Molten metal from a ladle furnace

An investment in Duisburg-Beeckerwerth worth millions makes the location fit for the future.

A ladle furnace is used in secondary metallurgy to treat molten steel. It occupies a position between the converter and the continuous caster in the production process of a steel plant. Its primary task consists in heating molten metal. The construction of the new unit will enable the Steel division of thyssenkrupp to expand its product portfolio to include materials with high-alloy qualities. Demand for these special types of steel is constantly increasing, especially in the automotive industry. The new equipment consists of a double ladle furnace with a capacity of 265 metric tons. It will enable the company to increase energy efficiency and reduce overhead.

In addition, a dust extraction unit and alloy facility is being built at the oxygen steel plant in Duisburg in the course of modernization. thyssenkrupp is investing a total of approximately €40 million in this project. “It wasn’t an easy decision for us to make,” says Andreas Goss, CEO of the Steel division. “But it was our way of sending a signal that the German steel industry in general and our location in particular are fit for the future.” The new ladle furnace can treat types of steel that contain alloying agents in excess of five percent (for example, manganese). This enables us to produce tougher materials for lightweight automobile construction and more.

For more information visit:
www.thyssenkrupp-steel.com/magazine/car

A new name for Hoesch Hohenlimburg

The Group’s precision hot strip specialist is now being given a new company name as part of thyssenkrupp’s new brand image and umbrella brand strategy. As of July, the company will be known as thyssenkrupp Hohenlimburg GmbH. The specialist in hot-rolled steel strip will operate in the new Group structure as the Precision Steel business unit. Nothing will change where the customers are concerned; both the business model and the overall business processes will stay the same. Even the points of contact will remain unchanged.

50 thousand

kilometers is the total distance covered by the InCar®plus demonstrator in the course of its global tour of the world’s most important automobile regions. The project’s manifold innovations were presented to nearly every internationally important OEM and supplier.

Hot on the trail of rust thanks to electrochemistry

Scanning Flow Cell (SFC) is a highly developed, micro-electrochemical research method introduced in the Steel division in cooperation with the Max Planck Institute for Iron Research. It is a type of ‘rust task force’ that enables researchers to test and demonstrate the corrosion properties and long-term stability of metallic coatings. In this way, the SFC method is able to guarantee a high quality standard for increasingly complex steel surfaces. The microscopically precise analysis helps make it possible for customers to reconstruct and understand corrosion mechanisms to a high degree of detail.

2017 SolarCar: Friedbert Pautzke, Bochum University (left), and Dr. Reinhold Achatz, Chief Technology Officer at thyssenkrupp.

Under the Australian sun

Now that the World Solar Challenge (WSC) is over, it's time again for the next WSC. Planning is already well underway for the next solar-powered prototype. Research collaboration between Steel and Bochum University is about to enter another round, after successful cooperation on the thyssenkrupp PowerCore SunCruiser and the thyssenkrupp SunRiser. Plans call for the new model to incorporate the latest lightweight materials and the most recent developments in the areas of electromobility and energy efficiency. The next WSC in Australia is scheduled to take place in October 2017.

Management is restructuring itself

Starting in October the Steel division of thyssenkrupp will be operating with a new management structure and its steel business will be divided into business units. The CEO directorate will assume responsibility for 'Markets and Sales' under the leadership of Andreas Goss. 'Rolling and Coating' and 'Research and Development' will be combined in the Downstream production area under the leadership of Heribert Fischer. In the Upstream directorate, which concentrates on optimizing and increasing the efficiency of processes in the liquid phase (crude iron, crude steel), Arnd Köfler will take over from Herbert Eichelkraut in 2017, whose contract expires at the end of this year. The 'Finances' and 'Personnel and Social' directorates, led by Premal Desai and Thomas Schlenz, respectively, will remain as they are.

Crossing the sea at -164 °C

Now that its 9% nickel steel has been approved, steel is now certified with two more important classification organizations.

LNG tanker with spherical tanks: Natural gas can be transported by ship in its liquid state.

The coldest location inhabited by humans has a temperature of -68 °C. This temperature was measured in a village in the Sakha Republic, a federal subject of Russia. At this temperature everything freezes to ice. By contrast, natural gas liquefies when the temperature drops much further to -164 °C. The liquefaction of natural gas into LNG (Liquefied Natural Gas) enables gas to be transported and stored in tanks. The advantage? In liquid form, natural gas has 600 times less volume than in gas form. The pressure tanks require high-quality, low-temperature, 9%-nickel steels that remain tough even at temperatures of -196 °C. The material produced by thyssenkrupp steel has been approved by both major maritime classification organizations, Bureau Veritas and Lloyd's Register. The certifications are required before a company can even begin to be considered as a supplier for a shipbuilding project. For customers this means greater flexibility when making decisions. For Duisburg, the certifications open up additional sales opportunities for heavy plate with a maximum thickness of 50 millimeters.

For more information on this subject visit:
www.thyssenkrupp-steel.com/magazine/heavy-plate

Olympic hopeful from Duisburg

Levent Tuncat (27), Steel employee and taekwondo fighter, has qualified for the Olympic Games in Rio. This was possible in part because the employer of the industrial management assistant allowed him to go on leave to during preparations for competition. Tuncat is currently ranked third worldwide in the 58-kg weight class.

Title

Everyone starts small: Developers' ideas are tested for practicability during pilot production.

One thing is certain where both materials and materials specialists are concerned: The next generation is here.

Thinking about tomorrow today

engineering. tomorrow. together.

That's how thyssenkrupp makes its brand promise a reality. For us, 'tomorrow' means constantly researching new raw materials and production processes in order to meet the future needs of the market and our customers.

Text Judy Born **Photos** Dominik Asbach

No innovation without investment: The Surfaces pilot production facility, with its pilot plant for metal strip (right), hot dipping lab (upper left), and composite materials pilot plant (lower left), is always state-of-the-art.

Mobility is and will remain one of the megatrends of the future. It is an expression of freedom, independence, self-determination. Today, the desire for mobility is primarily satisfied by the automobile. And that is not likely to change in the foreseeable future, because any time enthusiasm for mobility decreases, it is balanced out by an increase somewhere else. This is true in part because of another megatrend: population growth.

More than a million cars are on the road worldwide right now. It remains to be seen whether we will soon be filling our tanks with gasoline or electricity or powering our cars with hydrogen or sunlight, and whether we will be doing it ourselves or letting robots do it for us. The car is the ultimate individual mode of transportation, even if it won't necessarily be the only one in the future.

As a result, car manufacturers need new ideas and models. Automobiles have to become more environmentally friendly and use resources more efficiently. They need to offer more comfort and safety. And they must become less expensive to produce and maintain. For the Steel division of thyssenkrupp, this means orienting the division's materials to the current and future requirements of automobile production. For example, the division needs to develop types of steel that offer greater potential for lightweight construction and a broader range of forming options, and in certain parts of the chassis it needs to offer both increased stability and greater flexibility.

Progress in these areas is plain to see at Westfalenhütte in Dortmund, the site of an important branch of thyssenkrupp's Research and Development division. It is here that the achievements of materials developers are cast in steel and become a reality. "At the end of the day, we're a miniature smelting plant," says Jens-Ulrik Becker, head of process development and pilot production. "Steel is smelted here just like at a big plant. It's annealed and hot and cold rolled, the only difference being that the quantities are small." The ideas for new materials come not only from the automotive industry, but from thyssenkrupp's Steel division as a whole. "Our internal customer base, if you will, is not limited to the materials developers from the Steel division. It also includes our coworkers in precision hot strip, tinplate, heavy plate, and electrical steel," says Becker. "That's because we are able to reconstruct many different facilities and produce both the thinnest tinplate and the thickest heavy plate." Ideas are in plentiful supply at the company, and there is always plenty to do, he reports.

The simpler the steel, the easier it is to copy: Rüdiger Mempel and Jens-Ulrik Becker (right) make complex visions of materials a reality.

Test runners: Klaus Koch (left) and Bernd Schuhmacher review various samples.

The Composite Materials pilot plant in action (top).

In keeping with the pioneering spirit, the latest innovation from the thyssenkrupp Group was conceived here: TRIBOND®, a composite material that combines various types of steel. Both the procedure and the materials technology were developed in Dortmund. "This time around, the development came entirely from our team," says Becker, "and that's what makes this composite material unique in many regards."

TRIBOND® 1200 and 1400 were developed especially for hot forming and are ready for production. The products consist of two outer layers of a ductile steel surrounding an ultra-high-strength steel core. The composite material functions as a modular system whose properties can be modified to suit a particular application based on the configuration of the materials. The automotive industry will not only benefit from the product's potential for lightweight construction. TRIBOND® has a higher energy absorption capacity than standard hot-formed steels, and that makes it suitable for use in entirely new areas of application, for example, in side members, where the material undergoes severe compression in the event of a crash, dissipating a great deal of energy in the process. This is an obvious application for cold-formed steels today. Under normal circumstances, however, Jens-Ulrik Becker and his team are service providers who implement other people's ideas. Examples include new, high-strength DP steels with exceptionally high elongation for use in cold forming. Like TRIBOND®, these high-strength steels are a good fit for the lightweight construction strategies of car manufacturers. And they are much easier to form, thanks to increased ductility and modern processing technologies. That makes them suitable for complex structural elements such as B-pillars, a typical area of application for hot-formed steels.

Researchers in Dortmund are also testing steel-plastic sandwich materials at a pilot plant to keep weight down. Not only could these materials exert a major influence on future automobile construction, they could also offer an interesting alternative material for many other areas.

The search for ideal surfaces

However, a new product at thyssenkrupp still has to pass through additional stages before it is ready for the market. The usual procedure is for Becker and his employees to pass the new material on to the Surfaces pilot production facility, where Bernd Schuhmacher and his team work on coatings for new steel grades. This is a crucial job, because more than 80 percent of thyssenkrupp's rolled steel destined for automotive customers undergoes surface treatment prior to delivery.

“Steel can heal itself.”

As Managing Director of the Max Planck Institute for Iron Research, Dierk Raabe is on the lookout for materials with intelligent properties.

Interview Judy Born

What does the Institute do?
We conduct basic research, like all the institutes belonging to the Max Planck Society. In our case, the research involves investigating metallic materials with a focus on iron and iron-related materials.

What distinguishes the Max Planck Institute for Iron Research from others?
We cooperate with the industry to a great extent. And our connection to it is growing because we also receive basic funding from the steel industry for our projects.

As Managing Director, do you conduct research yourself?
Yes, I do. In this position one has to take care to be more than just a manager or an administrator. Research has to be sustainable, meaning that it takes perseverance, among other things. Work on a single development can drag on for decades. I can’t be everywhere at once, but I do still play a very active part in my own research programs.

What’s the last thing you researched?
Correlating atom probe tomography. This approach is based on the idea that in principle you can recognize every single atom as a chemical species and assign it a position in the material. If, for example, there are hydrogen atoms in a high-strength material, this can lead to failures that may have catastrophic consequences. Think about the undercarriage of an aircraft, for example. Atom probe tomography makes it possible to dismantle metals atom by atom and determine their behavior. Even minor changes to the atomic contents of a given material can sometimes lead to massive changes in the material.

You are also researching what are known as ‘self-healing’ steels. What are those?
This approach is based on observations of the human body. When we get injured, our body is usually able to heal itself. Take, for example, a broken bone or a laceration on the skin. Our body recognizes that the tension between the cells has changed at the site of the injury and it activates mechanisms whose purpose is to put things back in order.

And can the same process be translated to inorganic materials?
Absolutely! The advantage is that atoms don’t stay in one place, but wander to and fro. Their mobility and binding energy vary depending on their environment, which can be influenced by increasing the temperature, for example. We are currently conducting tests on steels and nickel materials that were designed for high temperatures and will be used in the making of turbines for power generation. In practice this means that when I introduce specific, sufficiently flexible atoms into a material and the turbine sustains a small tear or a pore, then these atoms will wander in larger numbers to the site of the defect and seal it up under ideal circumstances, provided the defect is small enough.

So steel is a clever material…
There is a term for this: smart materials. It refers to materials whose purpose changes when their boundary conditions change. For example, there are magnesium alloys that disintegrate and dissolve inside the body. Imagine an implant that only needs to be in the body temporarily, for example, screws that help a broken bone mend. If the wound grows together, the doctor will have to operate to remove the screws. But there’s no need for an operation if they dissolve on their own.

… and does steel still have a future?
Of course! There is enormous demand for steel worldwide. High-rises and plants of all shapes and sizes, bridges, and many more things would be unthinkable without steel. The biggest challenge for the steel industry in Europe is lightweight construction, because a large percentage of our sales come from automobile production. The construction industry is especially interested in intelligent materials. I’m thinking of communicating steels, which use acoustic properties or changes in resistance to inform engineers immediately when renovation is needed. Damage to bridges and high-rises can be recognized and repaired at an early stage. And in the future we will be dealing with smart buildings, too.

Materials scientist Dierk Raabe briefly studied orchestral music before he switched to metallurgy; he still plays a brass instrument.

Photos: Frank Vinken

Resistance spot welding: Two electrodes come together, current flows, and steel joins together.

The chemical composition of a steel grade strongly influences its coatability. "For example, we have a hot dipping laboratory where we can selectively reproduce the hot-dip coating process for new steels in small quantities," says the head of the New Surfaces and Pilot Production department. The same holds true for the coil coating lab, where organic coatings are applied by means of rolling. These high-performance laboratories make it possible to save on a lot of costly operating tests, which now only become necessary once the product has achieved the required degree of maturity in the laboratory. Another of the team's core areas is the BPA 300 strip pilot plant, a modularly designed research facility for 300-millimeter-wide slit strip, which runs through the machine at a rate of 60 meters per minute.

The facility is able to test a large number of coating and cleaning methods that have yet to become established in the steel industry. It functions as a kind of midwife, so to speak, for a number of different developments. One example is the zinc-magnesium product family, a hot dipping process that has recently come to occupy a regular position in the steel portfolio as an outer shell coating for the automotive industry.

New material properties require innovative technologies. "Hot dipping and organic coil coating have really reached their limits in this regard," reports Schuhmacher. "By contrast, vacuum deposition, where the coating is applied as a thin film on flat-rolled steel, markedly increases the degree of flexibility in choosing the coating process." Developing and industrializing a technology like this is exactly what the strip pilot plant was built for. "Here at the pilot plant we can run tests under conditions that closely approximate those of large industrial plants. If it works here, it should be possible to develop an industry-compatible process." And if not, the tests will help set the right priorities at an early stage.

Cohesion is everything

But the best base material is useless if it cannot be processed. This means that steel grades not only have to be lightweight and crash-proof, they also have to be easy to form and join. "The most perfectly shaped component is worthless if you can't attach it to a car," says André Marx of the Press Joining and Bonding team. Whereas in production forming always comes before joining, research in the area of application technology in Dortmund examines both areas in parallel. "In addition to its mechanical technological parameters, the steel is characterized on the basis of its ability to be formed and joined."

The most popular joining process in Dortmund is resistance spot welding,

"The most perfectly shaped component is worthless if you can't attach it to a car."

André Marx, Press Joining and Gluing team

André Marx and his team weld together what goes together.

A question of configuration: The gas control installation maintains the right furnace atmosphere during hot forming.

Forming – the customer decides

Any car manufacturer who wants to achieve optimum results for his car in the area of lightweight steel construction and crash safety must use hot forming on some parts and cold forming on others.

thyssenkrupp Steel is diligently expanding its portfolio to offer customers **more freedom of choice with regard to hot and cold forming**. Today, the company offers raw materials with multiple properties such as TRIBOND®. Designed for hot forming, this composite material is suitable for manufacturing highly stable lightweight B-pillars **because it combines ductility properties with extremely high resistance to deformation**. It also features additional properties that enable it to absorb a great deal of energy, making it an excellent material for **side members** in the front ends of automobiles.

The new high-strength variants of dual-phase steel are another all-rounder. Apart from their ability to absorb large amounts of energy, they also offer increased strength and **improved forming properties** as compared to previous generations. As a result, highly complex structural components can now be formed via **cold forming**.

partly because it is of considerable interest to car manufacturers. As Marx explains, "resistance spot welding is so popular because it doesn't add any weight to the automobile, it achieves a high degree of joint strength, and it's almost invisible." As such, the method stands in stark contrast to mechanical joining, which leaves a visible mark or requires additional elements in order to join things together. A car can contain up to 5,000 welding points. A resistance spot welding operation is performed at every spot where steel is connected to steel. The operation may be two-sided in cases where it is possible to access both sides, or it may be a one-sided operation if the welder is only able to access the welding point from a single side. In both cases, the material is heated to smelting temperature at a specific location via electrodes carrying electrical current. Resistance heating then creates the welding point between two metal sheets. The process depends on a number of factors: the electrode force, the current, and the steel surface. "We develop materials and suitable surfaces that enable these joining processes to be used," explains Marx.

In practice, one also has to deal with differences in the thicknesses of the metal sheets, for example, when a thin outer skin is welded onto a thicker structural component. In addition, it is also sometimes necessary to weld different steel grades together. TRIBOND® posed a unique challenge for joining technicians in this regard due to its three-layer structure. "Our expertise in joining technology enabled us to overcome these challenges as well, of course."

But hybrid joining processes are also important, since not all components can simply be welded together. When two different materials such as steel and aluminum have to be joined together, bonding is used in some cases in combination with a mechanical joining procedure. The complications entailed by this process should not be underestimated. "Just think about using adhesive on the windshield of a car," says Marx. "It has to withstand extreme temperature differences without losing its adhesive properties." Hybrid joining processes are lately becoming increasingly popular in steel connections as well, due to the fact that using several kilograms of structural glue in a car increases the overall stiffness of the vehicle.

Finding the right form

Sascha Sikora is responsible for forming in Dortmund. His department tests the application of new materials and technologies in cold and hot forming. With TRIBOND®, he has already succeeded in creating an innovative material for hot forming that is ready for production. "We are currently developing new forming technologies and processes for cold forming that will help make it easier to deal with springback, one of the central problems associated with high-strength, cold formed steels," says Sikora. "Until now, springback has often prevented manufacturers from using this material in geometrically complex components such as B-pillars."

Given the rapidly increasing number of raw materials and technological concepts, automobile manufacturers will now have far more options for implementing their lightweight construction solutions in an individualized and customized way without sacrificing crash performance.

These innovative solutions are not a product of chance, but of ongoing development and continuous research. They highlight the versatility and attractiveness of the material and prove that steel is still a long way from the scrap heap.

Sascha Sikora heads the Cold and Hot Forming test area in Dortmund.

Inspecting incoming materials: As Head of Production at Sortimo, Werner Attinger keeps everything under control.

Tidy tools, tidy mind

Sortimo manufactures storage modules and vehicle racking solutions for field technicians.

Text Kirti Letsch

It is an inconspicuous item that you wouldn't even notice at first if you walked through the well-lit entrance to Sortimo. But the blue metal carrying case is what launched the company's business in 1973. Herbert Dischinger, founder of the company, developed the KM 321 carrying case specifically for handymen. The removable plastic boxes, which could easily and securely carry small parts such as screws and nails, were truly innovative at the time.

Forty years on, Sortimo is now a leading manufacturer of vehicle racking solutions, load securing systems, and mobile transport solutions represented in 35 countries. The portable systems are especially popular among handymen, contractors, and service technicians, as they are perfectly designed to keep various tools tidy and organized and feature modules that can be combined individually. "We now offer approximately 8,000 products, from complex vehicle racking equipment through to simple hose holders," says Werner Attinger, who oversees production, which takes place entirely at the headquarters in Zusmarshausen, Germany. Steel is an essential material here: Sortimo uses steel to design and produce not only the many metal components for its products but also the machines that are used in the plant's spacious halls. To enable this steel-heavy production process, the company relies on thyssenkrupp's Steel and Aluminum Service Center team, which has operated under the name thyssenkrupp Materials Processing Europe since 1 July.

Thin but stable

The prefabrication specialist, based in Stuttgart, Germany, supplies slit strip and sheet metal blanks, which are then stamped, bent, and in some cases deep drawn by Sortimo. The company uses approximately 2,000 metric tons of steel each year, the bulk of which comprises flat carbon steel from thyssenkrupp. This partnership goes back many years, which is a testament to the mutual trust that the two companies have for each other. "It is particularly important for us that our suppliers have quick response times. For example, if there is a problem with the materials or there are new requirements from new customers, we can always rely on our Stuttgart-based partner to get back to us promptly," says Attinger. Heiko Falk, Customer Service Representative responsible for the Service Center team,

The production carousel keeps turning: The metal frames pass through the coating machine (above), while drawer systems are waiting to be delivered (left).

> “It is imperative to have perfect steel as a basis in order to produce a high-quality product.”
>
> Werner Attinger, Head of Production at Sortimo

The history of the carrying case

Practical necessity inspired Herbert Dischinger to invent the KM 321 metal carrying case. The founder of Sortimo watched his customers transport their loosely packed tools for many years. In order to help them, he designed combinable plastic boxes with different sizes and a carrying case.

adds: “We supply hot- and cold-rolled steel, including SCALUR®, which is required at Sortimo due to its exceptional thickness tolerances. We of course keep a certain volume of this steel in stock at all times.” SCALUR®, from thyssenkrupp’s Steel division, is perfectly suited for deep drawing processes, which require thin materials and are used for internal structural parts when constructing cars as well as when building shelves and furniture, for example. “We use steel not only because it is so stable but also because it can be used in a wide range of applications. This is an important factor for our customers from trade and industry,” says Attinger. “This is why we are also interested in steel that retains the same level of stability even when it is thinner after being processed.” However, what is even more crucial is the high quality of the source material. “We attribute our market success to the durability and high quality of our products, which in turn depend on the quality of the raw material. It is imperative to have perfect steel as a basis in order to produce a high-quality product.” This sentiment reflects the motto that looms over the Sortimo production halls on large blackboards: ‘Other products may be cheaper but never better.’

Photos: Frederik Laux (4)

Steady brakes

Brake lines from TI Automotive allow automotive manufacturers to keep things safe.

Text Christiane Wild-Raith

Driving safely with steady brakes: Brake lines from the TI Group ensure that the brakes always work reliably.

Distribution of roles: Copper-coated hot strips are the source material for the brake lines (above). Coating: A tube is pulled through the liquid aluminum to be coated.

The secret to success: Stefan Pscheidl with the uncoated goods that are used to manufacture brake lines (below).

Most people associate Heidelberg with its world-famous castle and picturesque old town that exemplify German Romanticism. Others may think about the city's famous university – the oldest in the country. Very few associate the city with car parts. However, the majority of vehicles in the world feature at least one component that was manufactured in Heidelberg, which lies on the Neckar river.

TI Automotive's production facility in Heidelberg's industrial area looks like an ordinary factory from the outside. There isn't much to suggest that it is the birthplace of vehicle parts that keep drivers safe all over the world.
But this is where TI Automotive manufactures brake lines that are supplied to all major automotive manufacturers. The company's market share in Europe is around 60 percent.

The company has a long tradition dating back to 1922, when Harry Bundy founded Bundy Corporation in Detroit, Michigan – also known as 'Motor City.' His company made automotive history just a few years later when it became the fuel pipe supplier for Henry Ford's first production vehicle. In 1957, the company inaugurated its first German location in Heidelberg and changed its name to TI Group Automotive Systems in the late 1990s.

The automotive supplier's portfolio comprises powertrain systems, air conditioning fluid systems, pump and module systems, fuel tank systems, and fluid supply systems, which include the brake lines. "Our business is built on experience, reliability, and trust," says Stefan Pscheidl, Purchasing Manager for TI Automotive Europe. His customers need to be able to rely on the high quality of his products. "And we in turn need to be able to fully rely on our suppliers." TI Automotive has a very special relationship with thyssenkrupp's Steel division. The steel manufacturer has been supplying TI Automotive with hot and cold strip for over 30 years. "We have developed a product specifically for this customer," says Barbara Dornbusch, Key Account Manager for cold rollers. thyssenkrupp Steel sends pickled hot strip to TI Automotive in Liège, Belgium, from the south of Duisburg, Germany. This hot strip is particularly thin, with a width of 700 to 718 millimeters, making it a very special product indeed. "We have fully focused on the customer's requirements," says Barbara Dornbusch. thyssenkrupp Steel keeps enough material in stock, which in turn allows TI Automotive to keep its stock volume in Liège at a bare minimum. "This demonstrates the success of our great collaboration," says Stefan Pscheidl. Furthermore, the distance between Liège and Duisburg is only 200 kilometers, and this proximity makes it easier for the two companies to coordinate their collaboration. There are several long-term contracts between the two companies, which allow the supplier to plan for the necessary capacity well and ahead of time. This then means the customer can rely on a dependable supply of the product in consistent volumes. "The quality of the material is absolutely crucial for us," says Pscheidl. "This is why thyssenkrupp falls under our list of 'preferred suppliers'."

"We need to be able to fully rely on our suppliers."

Stefan Pscheidl, Einkaufsdirektor TI Automotive

thyssenkrupp Steel smoothes the surface of the hot strip and coats it with nickel and copper at the plant in Liège. The supplier then sends the material to Heidelberg, where the flat slit strips are rolled to produce double-wall steel tubes that then receive a thin protective coating made of aluminum and polyamide to protect them against corrosion and abrasion.

TI Automotive produces approximately 500 kilometers of brake lines in Heidelberg every day, which corresponds to the distance between Hamburg and Frankfurt am Main. An average of ten trucks leave the headquarters in Heidelberg every day to deliver the products to the company's own system plants that are located very close to the customers. The brake lines are cut, bent, and equipped with connectors at the system plants – the only task left for the automotive manufacturers is to install them. The brake lines ensure that drivers all over the world are safe in their vehicles.

Photos: Martin Wagenhan (4)

No light without reflectors

A miniature object with maximum effect: The material for headlight reflectors (shown here from VW) comes from a roll of slit strip (right).
Visiting a location in Wuppertal: André Bovenkamp (left), Frank Rateitschek, and Justyna Finke.

You can't see a thing without light, as every driver knows. But few would guess that a little part weighing just eleven grams is what ensures optimal low-beam light. The part is known as a headlight reflector, and HÜHOCO makes millions of them.

The Steel division of thyssenkrupp has been producing the basic material for the part for 20 years. The Duisburg site is the sole supplier of 0.55 millimeter hot-dip aluminum-coated steel with premium surface finish. The delivery quantity of approximately 1,100 metric tons per year is rather small, reports Frank Rateitschek, a customer consultant at thyssenkrupp. But the challenges involved in producing this niche product are that much greater. Since each component measures just five by ten centimeters, an unthinkable quantity of headlight reflectors can be produced from this material each year. The parts are used around the globe, because HÜHOCO delivers them to international headlight producers, who then offer them to car manufacturers worldwide. Managing partner André Bovenkamp has spent the last 15 years making a global player out of a holding company that was founded in 1893 and specializes in metal coatings. "The requirements are high. The products are coated on one side and must be able to withstand temperatures of up to 400° Celsius," says Bovenkamp. "To achieve this we have developed a temperature-resistant bituminous coating technique. Our coating has to have certain properties, like the steel. For example, it has to bond firmly to the substrate, yet remain formable." Where primary materials are concerned, Rateitschek always keeps his customer's current needs in mind. He sees to it that supply processes run smoothly at the head office in Wuppertal, together with purchasing manager Justyna Finke. But there is more to the job than simply ensuring high quality and outstanding value for the price. They describe their approach to communication as follows: "We work together on many levels and help each other develop."

The HÜHOCO group is called in wherever there is a need for firm bonds between metal and rubber or plastic. The group is considered a leader on the world market in the area of adhesive-coated metal strip. And despite the fact that three quarters of its sales come from dealings with the automotive industry, the medium-sized company has made a name for itself thanks in part to the diversity of its product portfolio.

Many of its products, such as curtain rods and tabs for loose-leaf binders, can be encountered in everyday life. Anyone who spends their workday in safety shoes probably stands on metal inlays that went through the first stages of production in the mountainous region. dhp

The HÜHOCO group finishes metal surfaces that are used as headlight reflectors to ensure good visibility.

It's all in the coating: the coated material is unloaded.

Photos: Julia Unkel (3), thyssenkrupp Steel Europe photography

Gaining speed

The NGOflex service campaign from thyssenkrupp's Steel division aims to provide fast, flexible deliveries of non-grain-oriented electrical steel.

The automotive industry is facing a fundamental transformation thanks to networked vehicles, autonomous driving, and alternative engines. Electromobility is the primary focus where the latter is concerned, and it requires non-grain-oriented (NO) electrical steel. The Steel division of thyssenkrupp has been researching and developing solutions in this area at its Bochum location as a full range supplier for decades.

Marketing for the product will be based in the Sales Automotive division from now on, in view of the fact that the material is becoming increasingly important for automobile manufacturers. The new NGOflex restructuring program will seek to optimize the production process in the division. Jörg Paffrath and Bernhard Osburg, the heads of the Sales Industry and Sales Automotive divisions, talk about the changes.

What is NGOflex all about?
Paffrath: NGOflex is essentially a way of realigning the NO Electrical Steel business unit. The program is our reaction to our customers' requests for greater flexibility with regard to delivery dates and the diversity of types.

How do you plan to achieve that?
Paffrath: Experience has shown that we have a high degree of standardization at the beginning of production. Furthermore, at the second preliminary stage we are already able to meet approximately 80 percent of our customers' needs and stockpile adequate short-term stock. Our ongoing business relationships enable us to effectively plan this preliminary phase.

What advantages does this offer?
Paffrath: With the primary material we already have available we can produce the product on short notice in accordance with customer specifications, meaning that we can deliver faster. There is a market and a willingness to pay for deliveries with binding deadlines of just a few days.

There's more and more talk of electromobility...
Osburg: That's right. We start with the assumption that demand in this area is increasing and market growth is accelerating, partly in response to continuing reports of manipulated consumption data. In addition, our portfolio comprises the entire range of NO electrical steel, from low to highly siliconized grades. The requirements placed on the material are very high, and we are constantly looking for new areas of application.

Are you talking about the Applications Technology unit?
Osburg: Exactly. Our team at the Bochum location has decades of experience in this area. And our customers know how valuable that is. Then, too, there is the engine test bench, where we can simulate a lot of different things. Customers are eager to make use of it as well.

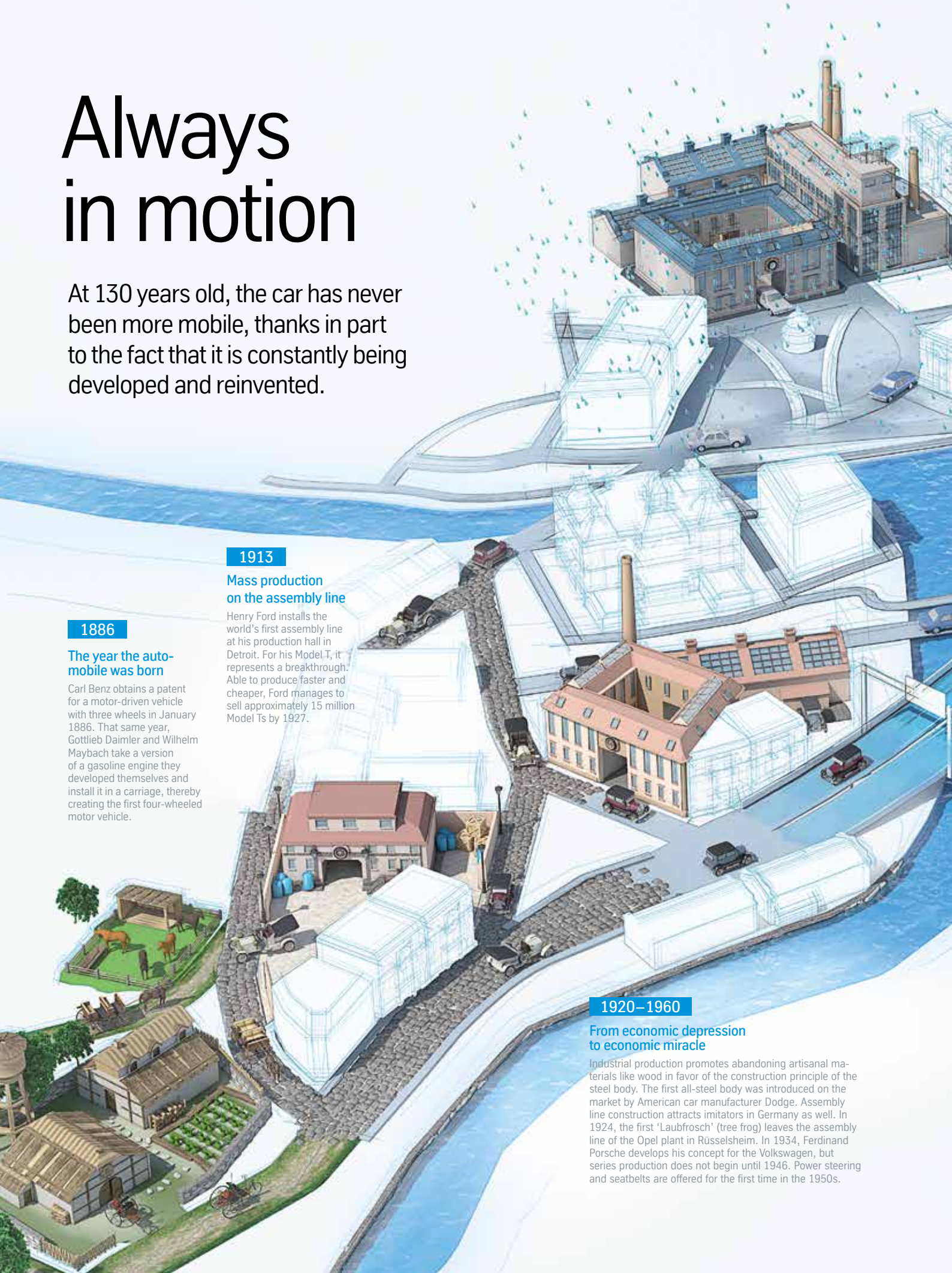
Will NGOflex lead to organizational changes?
Yes. In the first place, sales of NO electrical steel will be moved from my area to that of Mr. Osburg. Furthermore, an account organization will also be introduced to enable us to meet the needs of our customers as effectively as possible. We have also established the Inside Sales area, which primarily deals with order management. But the customer will still have the same direct point of contact. jb

Jörg Paffrath (left) and Bernhard Osburg see clear opportunities for growth in NO electrical steel.

Volker Kamen, NO Electrical Steel, (+49-234) 5085-1333, volker.kamen@thyssenkrupp.com

Always in motion

At 130 years old, the car has never been more mobile, thanks in part to the fact that it is constantly being developed and reinvented.



1886

The year the automobile was born

Carl Benz obtains a patent for a motor-driven vehicle with three wheels in January 1886. That same year, Gottlieb Daimler and Wilhelm Maybach take a version of a gasoline engine they developed themselves and install it in a carriage, thereby creating the first four-wheeled motor vehicle.

1913

Mass production on the assembly line

Henry Ford installs the world's first assembly line at his production hall in Detroit. For his Model T, it represents a breakthrough. Able to produce faster and cheaper, Ford manages to sell approximately 15 million Model Ts by 1927.

1920–1960

From economic depression to economic miracle

Industrial production promotes abandoning artisanal materials like wood in favor of the construction principle of the steel body. The first all-steel body was introduced on the market by American car manufacturer Dodge. Assembly line construction attracts imitators in Germany as well. In 1924, the first 'Laubfrosch' (tree frog) leaves the assembly line of the Opel plant in Rüsselsheim. In 1934, Ferdinand Porsche develops his concept for the Volkswagen, but series production does not begin until 1946. Power steering and seatbelts are offered for the first time in the 1950s.

1970–1980

For more safety and less rust

Manufacturers increasingly turn to galvanized steel sheet to avoid the problem of corrosion. The 1972 Subaru Leone is the first automobile with all-wheel drive to be mass produced. Two years later, General Motors develop the first catalytic convertors for gasoline engines. Mercedes equips its S class with the first ABS, and then with a driver-side airbag later on.

1990-2000

New materials at the turn of the millennium

Requirements such as stability (crash behavior), weight (lightweight construction), and appearance (aerodynamic, flexible forms) become increasingly important. This leads to the development of new, mild steel grades that are easy to shape as well as higher-strength grades with acceptable forming properties. The first automobile with a hybrid engine enters production at the turn of the 21st century.

2016

A structural change is imminent

An automobile's prestige is no longer determined by its size or horsepower rating. Efficiency and flexibility are crucial. To address these changes, innovative, higher-strength steels, material compounds, and production processes are being developed. Car sharing models are making major strides, especially in urban areas. R&D departments are busy with technologies such as driver assistance systems and steer-by-wire/brake-by-wire or with the transition to electromobility.

Future

The beginning of the multi-mobile era

More people will be on the go much more often in the future. And so mobility by the middle of the 21st century will not be limited to new types of engines and spatial movement. Sustainability, new energy infrastructures, and post-fossil fuel mobility concepts will also play a part, as will networked cities, car-to-car communication, and intelligent transport systems. Products and services connected with mobility will also remain a major growth market in the future as well.

Infographic: C3 Visual Lab

Staying in tune with what the future holds: Lutz Eckstein (left) and Lothar Patberg in ika's acoustic room in Aachen, Germany.

“James Bond himself would be jealous”

E-mobility shows the way forward – Lutz Eckstein, Director of the Institute for Automotive Engineering (ika) in Aachen and Lothar Patberg, head of Innovation at Steel, on innovative materials, modern technologies and a new driving experience.

Interview Judy Born

What are the challenges for creating the car of the future?
Eckstein: First of all, it is necessary to fulfill two requirements: Cars need to be even safer and be more efficient. However, what will ultimately sway a potential customer to buy a car will be its ability to create a positive, emotional driving experience. This is what we tried to achieve with our research car SpeedE.

What can the SpeedE do that cars available today cannot?
Patberg: It can make a turn in a single motion. The front wheels can turn by an angle of up to 90°, allowing the car to pivot around one of the back wheels. The driver operates the car using a side stick – like in airplanes – rather than a steering wheel. James Bond himself would be jealous!

It certainly sounds like a positive driving experience!
Eckstein: Doesn’t it! That is precisely our approach. We need to find out what the driver – that is, the customer – wants. To never feel stressed again about parking or making a turn, for example. Anyone who has always found it difficult to park will see a benefit in never having to maneuver their car into a parking spot ever again.
Patberg: That is our aim, and we are exploring what technologies and materials are necessary to get there. It is beneficial to our customers if we start investigating new materials at an early stage during these projects – that is, already during the designing and prototyping stages. This means our materials and technologies will be truly tried and tested in early development stages.

What was the designing process in this case, with the SpeedE?
Eckstein: Electromobility has given us an entirely new starting point. We could never have achieved such a large steering angle if we had to fit a combustion engine in the front end. Our main selling point – more so than the electric drive itself – is the experience of driving an incredibly agile car.
Patberg: Potential customers would have no interest in buying the car if, other than featuring an electric engine, it was just like any other car. It only becomes a more appealing product if we successfully integrate additional incentives and create added value.

A bit like the iPhone when it was first released?
Patberg: Yes, exactly like the iPhone. Many of its technical components were actually already available. But Apple integrated the parts in an intelligent way – introducing a user interface that was completely new for a phone, as well as a stylish design.
Eckstein: We need to approach electromobility in a similar way. We need to let the driving experience determine our choice of components and create added value. Only then will the car succeed. If the iPhone’s only function had been to make phone calls, it certainly would not have had such success.

Regarding stylish designs: ika from RWTH Aachen University recently opened the German Design Studio Aachen in collaboration with the Transportation Design department at Pforzheim University. What was the motivation for this move?
Eckstein: As strange as it may sound, we are trying to free ourselves from technical considerations. We are approaching cars first and foremost from a design perspective, worrying about the technical implementation only afterwards.
Patberg: Our aim was to give drivers the experience of making a turn in a single motion. This meant that the front end of the vehicle had to be redesigned, since the front wheels need-

Photo: Rüdiger Nehmzow

Research vehicle ready for the road: The SpeedE’s front end is made out of a steel-CFRP sandwich material.

ed a lot more space to achieve such wide steering angles. This in turn meant the vehicle's side members had to be closer together, making them subject to greater loads in the event of a crash. And this is exactly why it was necessary to develop our new composite material!

So you start off with the assumption that everything is possible?
Eckstein: A can-do attitude is crucial for this collaboration. We engineers first take a step back in order to understand the design. What is the experience we are trying to create? It is our task to then turn this into reality.
Patberg: One way or another, technology will always continue to develop. If you think about it, it already feels rather archaic that we still need to make three or more motions in order to make a turn – 130 years after the invention of the automobile.
Eckstein: The SpeedE features drive- and brake-by-wire systems, including a single-wheel steering mechanism and side stick controller. These are all things the automobile industry didn't even want to imagine just a few years ago.

What else can we expect to see?
Eckstein: The next development might be in air conditioning. What else can be done to maintain temperature-controlled surfaces inside a vehicle? The current approach is to heat up or cool down air and blow it into the vehicle. This is an outdated principle that is not very efficient.
Patberg: However, we should also point out that temperature-controlled surfaces are a research area that needs to be developed for somewhat longer before we can introduce it to our customers. But the idea does demonstrate how much potential there is in materials – especially in combining materials.

A positive, emotional driving experience will soon become a key reason for buying.

Lutz Eckstein

Everything is still being researched and developed, but is showing a great deal of potential.

Lothar Patberg

People

Lothar Patberg
studied engineering at the ika of RWTH Aachen University and completed the Executive MBA program at the University of St. Gallen and RWTH Aachen University. He has been working in the Steel division at thyssenkrupp since 2001, where he later started the Innovation department in 2010.

Lutz Eckstein
is the chair of the Institute for Automotive Engineering (ika) of RWTH Aachen University. He is also the chairman of the advisory board for fka Forschungsgesellschaft Kraftfahrwesen mbH Aachen. He has a PhD in mechanical engineering and previously held management positions at Daimler AG, BMW AG, and others, for 15 years.

It seems clear that car manufacturers are always searching for something new. What role does innovation play for suppliers?
Patberg: You can tell that a transformation is currently taking place. Suppliers need to develop their own ideas and offer new products now more than ever. This is exactly the path we are on at thyssenkrupp. What are the consequences if cars can suddenly make a turn on the spot? Will stronger and tougher steels be necessary? We need to think about mobility from many different perspectives, and materials will always play an important role.
Eckstein: We all need to be innovative in order to survive. This is true even for the automotive industry, especially with new, innovative competitors on the scene. Though they are less established, they also have fewer plants and assembly lines that need to be kept at capacity – and fewer employees they need to employ.

Finally, the notion of mobility seems to affect more than just how we drive cars…
Patberg: Absolutely. Mobility is a flexible concept with far-reaching implications. It is closely interlinked with urbanization, environmental protection, and conservation of natural resources. It also begs the question: What consequences will it have on the city of the future? On the infrastructure, on the quality of life, on private and public transportation?
Eckstein: Electromobility may offer a way to find a solution to these questions if we realize its potential and investigate what kinds of driving experiences it can lead to. If we harness electromobility to facilitate emotional experiences, we will open up completely new dimensions.

Photos: Rüdiger Nehmzow (2), PR

Dates

2016

September

Alihankinta, Tampere, Finland
27–29 September

The subcontracting fair takes place in Finland and is popular among visitors from Scandinavia and Russia. thyssenkrupp's Steel division will also be attending with its heavy plate high-strength and wear-resistant steel products. The company will be a co-exhibitor at a shared booth with long-term retail partner Flinkenberg.

WindEnergy, Hamburg, Germany
27–30 September,
Hall B6, Booth 232

The WindEnergy expo will take place once again in Hamburg, where thyssenkrupp will return as an exhibitor. The trade fair will bring together the international onshore and offshore wind industry's entire value chain, offering a comprehensive overview of the current state and future of the industry. The scope of the trade exhibition includes systems, components, planning and implementation, materials, production, and energy storage. It will also feature maintenance, certification, and quality management.

Oktober

Coiltech, Pordenone, Italy
28–30 September
Hall 9, Booth D7–E12

This is the eighth time that Coiltech, an exhibition for coils, electric engines, and transformers, will open its gates in the Italian city of Pordenone. Exhibits will include all kinds of materials, machines, and services for the production of electric engines, generators, and transformers. This is a crucial opportunity for thyssenkrupp's Steel and Electrical Steel divisions to display their products and services.

EuroBLECH 2016, Hanover, Germany
25–29 October,
Hall 17, Booth E33

thyssenkrupp Steel will attend Europe's largest sheet metal exhibition with other thyssenkrupp subsidiaries, presenting innovative solutions for industrial sheet metal processing methods suited for various industries. The exhibition will focus on production optimization, energy efficiency, innovation, sustainability, and the expansion of research and development for all companies wishing to invest in the future.

November

Stahl international annual meeting, Duesseldorf, Germany
10 November
CCD Congress Center, CCD Süd

This year's Stahl international annual meeting will be attended by thyssenkrupp Steel, sharing a booth with two sister companies.

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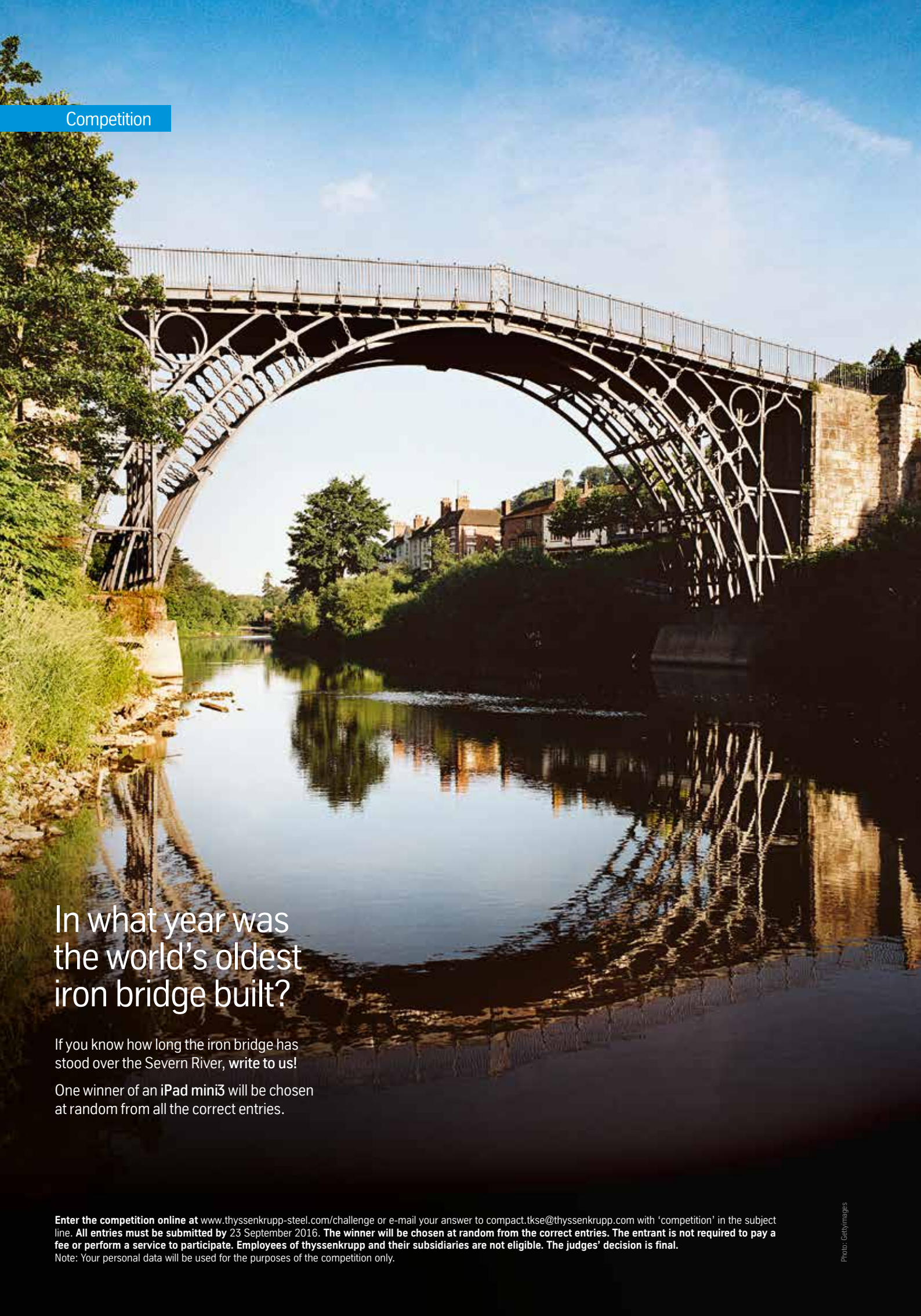
Op art in research and development – we held our agenda interview in the acoustic room at the Institute for Automotive Engineering (ika) in Aachen, Germany. Posing with the SpeedE are (from left to right): Lutz Eckstein (ika), Lothar Patberg, Christina Ehling (both thyssenkrupp), Roland Wohlecker (fka Forschungsgesellschaft Kraftfahrwesen mbH Aachen), and Clemens Latuske (thyssenkrupp).



Competition

In what year was the world's oldest iron bridge built?

If you know how long the iron bridge has stood over the Severn River, **write to us!**

One winner of an **iPad mini3** will be chosen at random from all the correct entries.

Enter the competition online at www.thyssenkrupp-steel.com/challenge or e-mail your answer to compact.tkse@thyssenkrupp.com with 'competition' in the subject line. **All entries must be submitted by** 23 September 2016. **The winner will be chosen at random from the correct entries. The entrant is not required to pay a fee or perform a service to participate. Employees of thyssenkrupp and their subsidiaries are not eligible. The judges' decision is final.**
Note: Your personal data will be used for the purposes of the competition only.

Photo: Gettyimages