

# steel

## compact



# Steel – Virtual yet real

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### Credits

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# “Let’s all work together to tackle the current crisis together.”

**A**ny crisis also represents an opportunity. This motto has become very popular again these days. But does the crisis truly offer an opportunity? When looking at the facts, we have rarely faced bigger challenges and crises that all need to be addressed at the same time.

The biggest one is the Corona pandemic, where we have entered the second wave. We at thyssenkrupp Steel are doing everything we can to protect our employees and to keep production up and running. So far, we have succeeded in doing so by acting quickly and in a consistent manner. This spring, Corona put the largest dent ever in Germany’s post-war economic history. Entire industries went into deep freeze overnight. This proved an enormous challenge for us, since shutting down was not an option. We substantially reduced the production capacity and are now ramping it up as demand is picking up again. But that’s something we can’t simply do at the push of a button.

Even without Corona, the steel industry faces major challenges, such as the ongoing problem of foreign imports. Europe needs effective protection against imports that rely on price and eco



**Bernhard Osburg**  
Chairman of the Executive Board,  
thyssenkrupp Steel Europe AG

## Information regarding this issue

**Dear readers,** this issue of steel<sup>compact</sup> contains photos taken before the Covid 19 outbreak. Many of the safety measures mandatory today were not yet commonplace at that time. For this reason, in some of the photos included in this magazine, people are not wearing mouth-nose masks or are not keeping the recommended safe distance. Please rest assured that as of March 2020, strict regulations have been put in place at thyssenkrupp Steel to provide all employees, partners, and customers with the best possible protection against getting infected with Covid 19. For more information on our safety measures and crisis management in response to the current pandemic, turn to page 4.

dumping. This is of particular importance to secure the success of the European green deal. After all, climate change does not go away because of Corona. We at thyssenkrupp take our responsibility very seriously and aim to produce up to three million tons of green steel by 2030 in the same grades and with the same quality we offer our customers today.

To enable thyssenkrupp Steel to best tackle these challenges, we are fast-tracking our own transformation. This includes restructuring measures and the systematic implementation of our Strategy 20-30 to continue to fully satisfy demanding market and customer requirements in areas such as e-mobility, high-strength steels, and surfaces today and in the future. As one of our initial investments, we have just launched a project to introduce a new walking beam furnace for the production of sophisticated surface-coated products.

The sum total of the challenges is enormous. But this pressure also ensures that positions have become clearer, goals are more clearly in focus, and processes are being streamlined. In this respect, the crisis truly can be an opportunity by providing an incentive to take courage and make the right strategic decisions.

# “We keep on cooking despite the global crisis”

thyssenkrupp Steel is responding to the challenge posed by the **Corona virus** with energetic and efficient crisis management. A pandemic crisis team comprising executives and works council members has implemented numerous measures to keep the company fully operational even during the crisis. Colleagues from across the company explain what keeps operations going at the steel mill.

Text Jan Ritterbach

## “We implemented protective measures in no time at all”

Markus Wischermann, CEO Hot Metal and Head of Crisis Management



“Considering that we were taken completely by surprise by Covid-19, just like everyone else, the measures we implemented in an immediate response took effect very quickly. Right when the pandemic started, we worked together with production, human resources, and the works council to draw up a comprehensive hygiene concept, which was approved and even highly praised by the district government. We rapidly implemented protective measures, put together a comprehensive crisis communication system, and set up completely

new processes as needed – such as a logistics process to ensure that every department and all production plants are always adequately supplied with protective items such as oronasal masks, disinfectants, and gloves. We also ensured that around 3,000 employees were able to work out of their own home at short notice.”



## “Contact with customers has intensified”

Anja Brüggemann,  
Key Account Management

In these particularly challenging times, close cooperation with our customers in a spirit of partnership is extremely important. With a view to our American customers and the time difference involved, home office work is one example of how I, in my role as Key Account Manager, have gained even more flexibility to look after our international customers. In this context, I have noticed that communication with my contacts in the U.S. and in France has even intensified as compared with pre-pandemic times. The ability to set up video calls makes it possible to get together at short notice and without complications – even several times a day if necessary. This is extremely helpful in the age of Corona as it allows me to exchange information quickly and, above all, promptly.”



## “Eager to quickly define a ‘new normal’”

**Marcus Löffler,**  
HR Business Partner BU Upstream & Head of Crisis Team

“In order to coordinate and implement Corona protection measures as pragmatically as possible with all relevant parties, such as the works council, occupational safety, corporate communications, and purchasing, we established a Corona Management program organization. Its central decision-making body is the crisis management team, which distributes information across the company via a coordination committee that collaborates with the production and administrative departments, as well as an exchange committee that interfaces with our partner companies. Crisis management and the protection measures taken have also been set down in a general works agreement valid for the duration of the pandemic together with the works council. In this way, we strive to act quickly yet safely to provide the greatest possible protection for our employees and define a ‘new normal’ together with all parties involved.”



## “Questions are being answered around the clock”

**Dr. Jörg Augustin,**  
Senior Company Doctor thyssenkrupp Steel

“We have adapted workplaces to suit the situation by installing plexiglass partitions, for example, in order to further minimize the risk of infection. We carry out hygiene inspections in the company and thus also act as contacts in the steelworks. Moreover, a Corona hotline has been set up to answer our employees’ questions around the clock, even on weekends. And it goes without saying that we and our team in the company medical service tested more than 1,200 employees for Covid-19 up to and including November. These tests focused on colleagues who developed symptoms or had been in contact with infected individuals. The laboratory that we cooperate with can usually provide the results online within a single day, which significantly contributes to simplifying health management during the current crisis.”



### Posters bolster our prevention effort

thyssenkrupp Steel is using a wide range of communication media to raise awareness among employees of the need to comply with **safety regulations** during the Corona pandemic. A colorful example of this are the various prevention posters put up across all departments. They remind staff to wear mouth-nose covers and to keep a safe distance.



# A dazzling look

ZM Ecoprotect® is a new thyssenkrupp Steel product that raises the bar in surface coating. The zinc-magnesium coating, which is applied to our products on various hot-dip coating lines, offers optimized pressing plant performance, improved corrosion behavior, and excellent paint adhesion. ZM Ecoprotect® protects car body parts from corrosion, particularly at the cutting edges and where parts are subjected to rain and humidity. These properties and the high-quality surface finish make this product the first choice for the visible outer paneling. Or to put it shortly: Let it shine!





# Knowledge & value

## A good idea



## Smart drying of raw materials

A steel company like thyssenkrupp Steel is dependent on a regular supply of raw materials. These are delivered to the plant's own port in Duisburg day in day out, usually outdoors and in any weather. However, some of the raw materials become sludgy when they get wet, which makes loading impossible. So how do you get the raw materials dry again quickly? The sudden inspiration of how to solve this problem hit Dr. Stefan Wienströer at home: The father of two discovered that sodium polyacrylate is commonly used in baby diapers. It's a so-called "superabsorber" that can absorb many times its own weight in liquids. Such superabsorbers are now added to wet cargo to dry the raw materials in the port within a few hours, making them ready for further handling.



**thyssenkrupp Steel – across all channels!**

Stay up to date about the latest trends in the steel sector. Follow us online! We are present on all popular social media channels.

## Investing in the future in Andernach

Tinplate packaging from thyssenkrupp is the first choice in a wide range of products. It is lightweight, robust, sustainable, and now produced in a chromium (VI)-free manner.

A state-of-the-art coating line for chrome-plated packaging steel is currently being built at thyssenkrupp Rasselstein GmbH in Andernach, Germany. If everything proceeds as planned, the plant will chrome-plate blackplate strip based on a new process as of 2022. The line was designed to supply customers with a future-proof product for the production of chrome-plated steel packaging. This will allow them to purchase the new packaging steel in good time before a corresponding EU regulation prohibiting the use of chromium (VI) comes into force.

It will provide the usual beneficial processing and service properties while being 100 percent chromium (VI) free. "This decision will allow us to supply our customers with our high-quality products based on an even more highly advanced process chain," explains Chief Technology Officer Oliver Hoffmann. "At the same time, it will contribute to further improving health and environmental protection measures."

### Web

For more information on tinplate, visit [thyssenkrupp-steel.com/en/packaging-steel](https://thyssenkrupp-steel.com/en/packaging-steel)

thyssenkrupp Steel has invested hundreds of millions of euros into this new technology in its ongoing mission to promote sustainability, process efficiency, quality, and competitiveness. Production is scheduled to take off in 2022.



## In figures

# 91.1%

is the current **recycling rate for tinplate** in Germany.

Tinplate is a true recycling champion in many regards: Even though products made of tinplate have a finite life cycle, this limitation does not apply to the metal used. Tinplate can be recycled an infinite number of times without loss of quality.



One advantage of our climate conservation concept is that we will continue to be able to offer our customers the complete product range – produced in an environmentally friendly manner.

**Bernhard Osburg,**  
Chairman of the Executive Board,  
thyssenkrupp Steel Europe AG

➤ Learn more about this on page 22.





## Rail transport

### Logistics is going digital

The call “paging the train driver!” has become a thing of the past at thyssenkrupp Steel in the northern part of Duisburg. Time-consuming voice radio communication has been replaced with an app, which allows work orders to be digitally recorded by the dispatcher and immediately confirmed and executed by the train driver. The railway is an essential means of transport at the mill. Raw materials and products are transported both on the premises and beyond the mill's gates via the company's rail network, which has a combined length of roughly 400 kilometers.

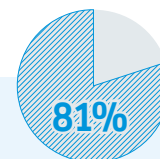
## The industry in brief

# 2/3

Presently, 2 out of 3 consumers today believe that digitization can help to save jobs that are threatened by Corona.

### Growing trust in digitization

A representative consumer survey conducted by the German Digital Industry Association (BVDW) shows how important digitization has become in the age of Corona.



81 percent of those surveyed believe that digitization will significantly influence and drive the relaunch of the economy and social life in Germany.

## Three questions for...



**Dr. Peter Biele**, CEO of thyssenkrupp Rasselstein GmbH in Andernach

### 1 What makes steel an ideal packaging material?

Packaging steel is produced from natural raw materials such as iron ore, coking coal and limestone, and steel scrap. The characteristic properties of this metal allow steel to be smelted over and over again and to be processed into a new steel product using resources that occur naturally. Better yet, this has no adverse effect on product quality and can be repeated indefinitely. Packaging steel is recycling at its best.

### 2 Consumers need to contribute?

That's right. When it comes to waste separation, cans must be discarded in the yellow recycling bag. Germany has an impressive tinsplate recycling rate of more than 90 percent. In this country alone, enough packaging steel is recycled each year to produce 27 Eiffel Towers.

### 3 Is it possible to reduce the amount of CO<sub>2</sub> released during steel production?

The recycling of packaging steel contributes to saving scarce resources and reducing CO<sub>2</sub> emissions. Each ton of steel scrap used in the production of steel prevents 1.5 tons of CO<sub>2</sub> from being blown into the atmosphere. In addition, thyssenkrupp is pursuing an innovative concept called tkH<sub>2</sub>Steel: In the future, a planned direct reduction plant with a melting unit is to be operated with green hydrogen. This blast furnace 2.0 represents a major step towards achieving our climate targets: 30% less CO<sub>2</sub> emissions in ten years and climate neutrality by 2050. At the same time, we are converting generated greenhouse gases into valuable chemical products such as methanol or ammonia.

## New process



### Efficient blast furnace

thyssenkrupp Steel is testing a new type of blast furnace technology in Duisburg to improve the efficiency of internal processes. The “sequence pulse process based on induced shock waves” is an innovative oxygen injection process specially tailored to the blast furnace process. It aims at improving the gas and liquid flows in the blast furnace to boost efficiency. This will result in an optimized consumption of the reducing agents coke and injection coal, thus reducing both CO<sub>2</sub> emissions and costs. Following a thorough research and development stage within the Group, the world's first plant was completed at the Schwelgern 1 blast furnace. thyssenkrupp Steel intends to use the technology to help reduce its own CO<sub>2</sub> emissions and, by marketing it worldwide, to make a contribution to reducing emissions on a global scale. The technology is already attracting widespread interest.

# Smart steel plant

Data has been playing a key role in the highly automated steel industry for decades. As **digital transformation** is changing the industrial sector, the intelligent use of data is opening up new avenues for further improving performance and quality in production.

Text Katja Marx | Graphics C3 Visual Lab

**C**an you see the car body in the center of the room? Come on, let's have a closer look at it," says the avatar next to me. I follow it, without moving from the spot, using my laser pointer. The vehicle is now right in front of me – a transparent, three-dimensional, virtual object. We use the shortcut menu to call up details about the high-strength steels used. Then we simulate a crash and check how it affected the materials. Do the weld seams hold? And is everything inside the vehicle still intact? I bend down to take a look through the door. I move carefully and twist my body in a funny way to avoid bumping my head. Someone next to me laughs out loud, and it's not the avatar. This brings me back to the fact that I'm standing in a meeting room with VR goggles strapped onto my head. My virtual conversation partner is actually in another room. So this may be a glimpse into the future of development collaboration.

Virtual engineering is all about saving development time, hardware, and avoiding expensive test series. Instead of a real-life crash vehicle, its digital twin – made up of 3D

Photos: thyssenkrupp Steel Europe photography

## Virtual Engineering





A person with dark curly hair is shown from the side, wearing a black VR headset and a blue long-sleeved shirt. They are holding a black VR controller in their right hand. The background is a large screen displaying a blue-tinted virtual environment with a car model and various interface elements. The person's head is tilted slightly downwards, and they appear to be focused on the virtual space.

In the virtual space, various detailed information about the vehicle can be selected and visualized via a shortcut menu. And any irrelevant detail can be hidden.





**This may sound trivial, but it's far from that. Data analytics requires a comprehensive and robust data foundation.**

**Plant control based on digital systems also helps to predict material properties more accurately, enabling customers to order them with ease.**

› data compiled from a large number of crash simulation calculations – is sent off to collide with a virtual wall. “This technology cuts development costs down to a fraction,” explains Erik Hilfrich, Application Technology Team Leader at thyssenkrupp Steel. “This process also means that we can simply send data around the world instead of bulky components, which greatly simplifies collaboration with our international customers. One of the many advantages is that we can examine vehicle crashes as often as we like, in slow motion and at close range. This also allows us to better present our development work.” In this sense, virtual engineering is also a tool that allows engineers to collaborate quickly with customers and colleagues across the globe.

### **All-encompassing data**

Data that can replace material? Is this how thyssenkrupp Steel envisions the steel mill of the future? Volker Lang, Head of Digitization & Architecture, firmly rejects this idea. “In our industry, things are a bit different than in the automotive industry. Long gone are the days when customers were just buying engineering skills; today, the whole package includes high-tech computers on four wheels. We are digitizing our core product steel. This means that in addition to providing traditional material properties, we now offer a more comprehensive range of services because we are becoming more flexible in

areas such as order processing. And this means that data is essential to us, too. We use data to better meet customer expectations and to optimize both our products and processes.”

A key goal of digital transformation is therefore to evaluate product and machine data across various process stages. For instance, data analytics can be used to predict material properties such as thickness fluctuations, roughness, or strength more precisely and to meet tolerances more accurately. Hundreds of thousands of sensors collect quality and production data across the entire flat steel process chain. This allows us to control and analyze production processes in real time. An interdisciplinary team, the Big Data Squad, develops mathematical models based on this data. One of these models has been controlling the skin pass mill of hot-dip galvanizing line 8 in Dortmund for a year now. It helps to ensure that the line now meets the target roughness values of the steel strips with even greater precision. “Previously, the plant controller essentially configured the machine based on experience. Our present model makes it possible to calculate the required roughness values for any conceivable order specification,” explains Yavuz Dogan, a member of the Big Data Squad. The advantage is that the digitally based system control already adheres to the tolerance range to a higher degree. This sets the stage for allowing the driving mode to be readjusted online whenever necessary, resulting in a better product.

### **Quality parameters create added value**

Meanwhile, an interdisciplinary team is conducting pilot projects in the area of horizontal networking. With this, we are mainly trying to answer the question of which product data relating to steel processing could also be made avail-





Data can be used to create three-dimensional images of materials, plants, or entire production lines, resulting in a “digital twin” that can be used to perform simulations, for example.

able to customers in the future? The advantages of such an exchange of data are clear to Lothar Patberg, responsible for the pilot project at thyssenkrupp Steel: “The data is available immediately after production of the coils. In the future, this could allow customers to go beyond simply tracking the current order status. By obtaining selected quality data, they could adjust their own processes even before the coils are delivered,” says Dr. Kroes. This would open up possibilities such as adjusting a pressing plant with enough precision that it will process steel strips optimally without a test run.

Considerations such as these are essential in setting the course for one of thyssenkrupp Steel’s key projects aimed at combining data from different process stages in such a way as to gain a highly accurate digital image of production. The benefits of such digital representations and the data transparency they foster would not be limited to downstream stages of the value chain. They would also have a self-reinforcing effect, as Lothar Patberg explains: “Digital >



Ultimately, the digitization of our value chain will further improve our performance and quality of the materials we produce.”

**Dr. Lothar Patberg**, responsible for the pilot project at thyssenkrupp Steel





Lars Bode with the Automotive business unit illustrates complex technologies such as smartform® (see p. 14) to his customers on a tablet via augmented reality (AR).

› mappings help us to better understand our processes. This allows us to identify and eliminate possible sources of error and failure risks. The digitization of our value chain will consequently further improve both our performance and the quality of our materials.”

### Rollers as a service

The Precision Steel hot rolling mill in Hohenlimburg serves as a good example of the advantages that come with a networked supply chain. Here, the individual production processes are orchestrated to such a high degree that the plant can offer its customers a unique service called “rolling as a service” (for more information, see p. 15). Here is how it works: Steel product customers enter their short-term requirements directly into the system, which triggers the production process. “Our customers require a high degree of supply flexibility, even for small batches. We can meet this special requirement thanks to our fully digitized ordering and manufacturing processes,” says Ulrich Schneppe, Head of IT at the Precision Steel Business Unit. At the other end of the supply chain, employees in the hot rolling mill control the occupancy of the continuous caster in the steelworks of their upstream supplier in order to

guarantee on-time and flexible product delivery. And there’s yet another advantage: This highly flexible production process results in smaller inventories, thus reducing tied-up capital on both sides.

### Smart speedboats

In addition to these major projects, thyssenkrupp’s digitization scheme includes various smaller undertakings. These help to close digitization gaps in logistics, optimize maintenance workflows, and ultimately ensure that orders are processed quickly and efficiently.

For the “Digital Innovation” team, the factory premises with their extensive rail networks, raw material ports, and stock warehouses is ripe with potential for digitization. The specialists work in a team called Digital Labs, where they develop hands-on prototypes in just a few weeks in collaboration with colleagues from the respective departments that will be using these innovations. The resulting solutions address concrete challenges and make day-to-day work easier. Examples include an app for the mobile inventory management of steel scrap or a track-and-trace solution that allows users to check the current location of coal and ore deliveries from Rotterdam in real time.



An app allows customers of the Hohenlimburg hot strip plant to specify coil data and place “one-click orders.”



The young team has developed more than 20 such solutions over the past three years. The “smart insight” augmented reality application, which enables maintenance personnel to look inside a machine using virtual “X-ray vision,” was developed in the lab up to the point where it was ready for practical use (for more information on this topic, see p. 16). “The development stage only lasts two to four weeks, which is a short period of highly focused work. This involves a fair share of discussions, which generate a tremendous amount of momentum. At the end of this stage, the final product is generally so good that team members would love to continue working on it,” says Tim Rupp. He and Tobias Eckhoff are part of the Digital Labs core team. “We work very independently and at the same time connect with almost all areas of our company,” says Tobias Eckhoff. “On the one hand, we are IT experts, but we are also change managers and cultural ambassadors. It is our task to get more and more colleagues passionate about the topic of digitization.”

### Digital is different

One thing that can be said about all of thyssenkrupp Steel’s locations is that the digital transformation is an open-ended process. The process may be set in motion by thinkers and engineers, but its implementation depends on each individual employee’s attitude and willingness to change. Therefore, getting them on board, sharing knowledge, and taking their concerns seriously are among the most important mission

parameters that apply to each of thyssenkrupp Steel’s solution-oriented digital projects.

Lars Bode from the Automotive business unit recalls the presentation of smartform® on the tablet, one of the first augmented reality applications the company adopted (see p. 14). The innovative smartform® process enables the production of complex components made of high-strength steels with minimal springback. This process can be demonstrated on the tablet in a highly realistic manner. “This simulation makes it much easier for us to exchange technical information about complex processes. However, we normally also take an actual component along so we can also show the real thing.” This is due to the fact that data can be experienced, but you can’t touch it. By the time VR goggles become a regular working tool, the machines in the rolling mills will probably have long since learned to share their data with the facilities at other locations.

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# Total impact

As these four examples illustrate, digital transformation affects all areas of the company.

## Products: Virtual visualization

The smartform® application for the tablet

smartform® is a patented process that has been specially developed for the cold forming of dimensionally stable steels in the 600+ megapascal range with the aim of preventing unwanted springback effects of the high-strength materials. The process comprises two stages: the production of a preform that approximates the final component geometry, and the subsequent adjustment of the dimensional accuracy in the actual smartform® – also known as the calibration process. Our team tackled the question of how to demonstrate this complex process in a clear and appealing manner. The solution thyssenkrupp Steel came up with replaces the traditional Powerpoint-style approach of showing a large number of sectional views with a new type of visualization based on augmented reality (AR). This allows our development engineers to take along a virtual presentation of the press, which weighs several tons, to the customer to illustrate the interaction between the tool and the component in a simulation. One of the key features of the tool is that customers can view the forming process and the how the material and tool interact in 3D.



## Supply chain: Maximum flexibility

### Giving customers control of the rolling mill

Seamlessly digitized ordering and production processes make order handling more flexible and increase transparency. The thyssenkrupp Hohenlimburg hot rolling mill is a pioneer when it comes to utilizing a fully networked supply chain.

The system allows customers to step into the production process directly and specify when their precision strip orders are to be rolled with a lead time of 48 to 72 hours. They can also readjust the material properties of the ordered products up to a few hours before rolling. After submitting the final parameters, the status can be tracked online via an app or similar interface. This also makes “one-click ordering” possible. But not only the customers benefit from this process. By networking the value chain, the thyssenkrupp mill gains the ability to intervene directly in the plant control system of its primary material supplier.

This helps to ensure optimal flexibility for customers on the supply side as well.



## Processes: Giving technicians X-ray vision

“smart insight” facilitates maintenance

Downtimes affect the delivery performance. Consequently, when a malfunction is reported, the valves or other machine components associated with the fault must be identified as quickly as possible to ensure rapid fault correction. The “smart insight” AR solution simplifies this identification process. First it guides the maintenance technician right to the affected machine using integrated hall schematics. Once there, the employee is provided with context-sensitive information. Users can click a component on the tablet to automatically call up relevant reference data, including maintenance information and recent repairs. It is also possible to investigate how individual components connect with the valves on the plant. This even includes hidden valves since the AR application enables the maintenance technician to look through the housing and into the plant interior. The first prototype of smart insight, which maps a system in cold rolling plant II, is now available.





## 4 Culture

### Culture: Smarter exchange

The digital community is growing

Digital transformation affects every single employee. That's why thyssenkrupp Steel promotes networks that bring digital experts and people interested in digital technology together within the company. One of these open platforms is the smart steel natives community, which around 500 employees have joined to date. They meet regularly, currently virtually, to present their own digitization projects, exchange ideas, and initiate change in their departments by submitting suggestions. At one of the last live events, board chairman Bernhard Osburg encouraged employees in his opening speech to take an open mind to digitization opportunities. In addition, the thyssenkrupp Steel change management team has launched the "learn-share-inspire" event series. Its main goal is to impart knowledge through inspiring presentations. The Extended Reality Day or Big Data Day provide further opportunities for digital communities to get together and discuss our digital future.



Unique fashion for exceptional people: august & alfred offers stylish streetwear as well as matching accessories with a feel of steel.



# Steel with style: Sustainable fashion made in Duisburg

In collaboration with the Grubenhelden fashion label, thyssenkrupp Steel presented its first august & alfred fashion collection in October 2020. What makes **august & alfred** stand out is that they use discarded smelter coats to craft unique jackets, hoodies, t-shirts, and accessories.

Text Jan Ritterbach

**a**ugust & alfred offers more than “just” cool streetwear for men and women. Each individual piece has a history deeply rooted in the Ruhr region. It’s a tribute to Germany’s cradle of the steel industry and the special brand of people who live there. All accessories and clothing items for the collection are hand-crafted in the inclusive workshop located on the company’s Duisburg premises. The workshop has been an integral part of thyssenkrupp Steel for many years. It gives employees who are no longer able to work at their regular workplace due to health reasons the opportunity to continue to make an important contribution to the company by creating services and products. It is their preparatory work that provides the basis for creating the final pieces at fashion start-up Grubenhelden. The proceeds from the sale go to the cooperation partners, and a share of the money is donated to a charitable cause.

## Symbol of the steel cycle

The entrepreneurial approach of august & alfred is reminiscent of thyssenkrupp Steel’s ability to change. Just as new things are created from recycled steel, the Duisburg-based steel company is constantly reinventing itself. In times that are particularly challenging for the industry, the idea of a young, financially self-sustaining fashion brand mirrors Steel’s own approach:





## “A tale of courage and creativity”

by Martina Merz,  
Chairman of the  
Executive Board at  
thyssenkrupp AG

A young fashion label and a steel company firmly rooted in the Ruhr region found a start-up. There are many reasons why this project is extraordinary. The main theme here is sustainability. After all, recycling is part of everyday business in the steelworks. And applying this concept to used protective clothing is a beautiful idea. But, for a different reason, the collaboration is also special from a social point of view. The fact that the collection of Grubenhelden (“mining heroes”) is being produced in the inclusion workshops in Duisburg takes the project to an even higher level. This is hands-on social responsibility at its best. Finally, this start-up is also a testament to courage, creativity, perseverance, and the passion to make a vision come to life. And this is precisely what entrepreneurial spirit is all about. The project team can be truly proud of what they have achieved.

**Sustainably fashionable: In its new collection, august & alfred uses, among other things, materials gained from old smelter coats.**



Both come up with fresh ideas that enable them to boldly move forward in the face of adversity. The continuous transformation of thyssenkrupp Steel as a trendsetter when it comes to modern technologies perfectly illustrates this. Measures to convert Europe’s largest integrated steel location into a climate-neutral steel producer at is already in full swing.

### Green steel is not wishful thinking

If the legislator creates the right legal conditions, climate-neutral steel production in Duisburg will be a reality by 2050. The first batch of green steel is expected to be available as early as 2022. Once the transformation is complete, the result will be quite impressive: 0 percent CO<sub>2</sub>, 100 percent steel. This will mark the sustain-

able result of pairing tradition with innovation – a recipe for success typical to the Ruhr region. One such example is the collection from august & alfred. “The august & alfred fashion brand is a tip of the hat to the home of the German steel industry and a testament to diversity,” says Frederik Hoffmann, Head of Inclusion/Workshops at thyssenkrupp Steel, who is in charge of producing the new collection. “The label pays homage to the steel workers and miners who call this place home.”

# Climate-neutral steel is within reach

Hydrogen is paving the way for green steel. thyssenkrupp Steel has now presented the **tkH<sub>2</sub>Steel concept** to make its entire range of steel grades climate-neutral by 2025.

Text Katja Marx

**O**n 28 August 2020, thyssenkrupp Steel reached a further milestone on the road to green transformation. It focused on the “Blast furnace 2.0,” a large-scale direct reduction plant with an integrated melting unit. What makes it special is that the solid material produced in the DR plant, the so-called “sponge iron,” is liquefied immediately and then processed efficiently in the existing steel mill network. “We want to use this green production channel to provide our customers with CO<sub>2</sub>-free steel, in the usual grades and across the entire product range,” explains Chairman of the Executive Board Bernhard Osburg. This will allow thyssenkrupp Steel to produce significant volumes of climate-neutral steel before the current decade comes to a close.

During a visit to the construction site for the first DR plant in Duisburg, Federal Minister for Economic Affairs and Energy Peter Altmaier and NRW State Premier Armin Laschet pledged their support for the project: “Steel is a key German industry, and we must do everything we can to ensure that climate-friendly and

competitive green steel will be produced in Germany in the future,” assured Peter Altmaier in reference to the Federal Government’s national hydrogen strategy.

## Taking CO<sub>2</sub> reduction to the next level

Starting in November 2019, thyssenkrupp Steel has been the first company in the world to test the use of hydrogen in ongoing blast furnace operation at blast furnace 9 in Duisburg-Hamborn. The company aims to achieve initial CO<sub>2</sub> reductions over the short term. Provided there is enough green hydrogen, the first batches of climate-neutral steel can already be produced.

The experts will build on this initial experience with hydrogen-based steel production in the next transformation project. In 2024,



## Important strategic decisions

The most important requirement on the road to achieving climate-neutral steel over the long run is the availability of hydrogen that has been produced using **renewable energies**. And we're talking about vast amounts of fuel: It will take approximately 3,000 wind turbines just to meet the annual hydrogen requirements of thyssenkrupp Steel in a climate-neutral way in 2050. The hydrogen strategies adopted by the German government and the EU provide an important starting point for establishing international partnerships and building a suitable transport infrastructure.





thyssenkrupp Steel will start up the first industrial-scale direct reduction plant at the integrated steelmaking site in Duisburg and will power production using green hydrogen in the future. The solid sponge iron produced there will initially be processed in the blast furnaces, resulting in further emission reductions. From 2026 onward, the company will expand the modern production facility by adding an electrically powered melting unit. These joint measures will create the first “blast furnace 2.0.” It will produce “electrical hot metal” for downstream processing in the proven BOF meltshop. The advantage of this is that the established steelmaking processes will remain in place – and with them the full range of steel grades.

This will make the first coal-based blast furnace obsolete. Another will be taken offline

**Federal Minister for Economic Affairs and Energy Peter Altmaier and NRW State Premier Armin Laschet have assured that the government will support this ambitious project.**



when the second, larger DR plant with an integrated melting facility goes into operation by 2030.

thyssenkrupp Steel is aiming for an annual production volume of three million tons of climate-neutral steel in the present decade. The company is staying on its course to reach full climate neutrality by 2050 with the introduction of two more integrated DR plants and the shutdown of the two remaining blast furnaces. Once this milestone is reached, CO<sub>2</sub> emissions can be reduced in the order of 20 million tons each year. This corresponds to almost 10 times the amount generated by annual domestic air traffic in Germany.

### Scoring with green products

By providing green steel, thyssenkrupp Steel is helping its customers achieve their own climate targets. This is good news to the automotive industry, the packaging and engineering sectors, and consumer goods manufacturers, who also need to significantly reduce their emissions in the coming years. The transition to green steel provides them with a comparatively low-cost means of reducing the carbon footprint of vehicles, cans, and bathtubs.

The automotive industry in particular benefits from the hydrogen-based steel production in Duisburg, as it will be able to order climate-neutral high-quality multiphase and lightweight steels, electrical steel, and grades with a high surface quality in the future. And since the quality-relevant processing stages remain unchanged from the steel mill onwards, costly recertification won't be necessary.

The technological foundations have been laid, and we have trained our sights on the ambitious goal of transitioning to green steel production by 2050. In the coming months, we will draw up the details for the sustainable restructuring of Europe's largest integrated steel location.

Highlighting the advantages:



Joining technology:  
Simple component geometries



Shielding:  
Electro-magnetic compatibility

# Steel: The material of mobility

When it comes to e-mobility, steel is “the material of mobility” because components made from modern lightweight steels are highly economical, light, safe, and sustainable. The scalable **selectrify® battery housing** perfectly proves this point.

Text Stefan Schrahe | Graphics C3 Visual Lab

**W**henever Dr. Daniel Nierhoff, Application Technology Engineer at thyssenkrupp Steel, goes on a business trip in the Duisburg and Essen region, he prefers to use

one of the electric cars the company has added to its fleet to gain hands-on experience with electromobility. “Simply installing a battery and electric motor instead of a conventional drive unit is no longer how things are done. The way that cars are being built is undergoing massive change. Second-generation electric cars require a design that accounts for completely different demands and at the same time opens up new possibilities,” he explains.

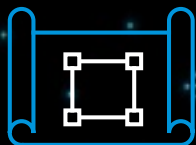
The engineer knows that long-established design principles no longer apply: “Electric cars do not need an internal combustion engine, a transmission, a tank, or an exhaust system. Even the center tunnel, which used to absorb the impact energy in

the event of a crash, has become obsolete because of the battery. All these changes allow us to approach the process from an entirely new angle, focusing on how we can accommodate the largest possible battery while ensuring maximum crash safety to optimize both safety and the vehicle’s range.” To demonstrate the vast potential of innovative steel solutions for electric vehicles, the Group has combined its electromobility activities under the name selectrify®.

After all, the mobility revolution depends on economical lightweight construction solutions and steel expertise. selectrify®







**Design:**  
Innovative  
multi-chamber  
steel profiles



**Costs:**  
Steel is up to  
50% percent  
more cost  
efficient



**Crash safety:**  
Maximum  
protection  
achieved with  
high-strength  
steels



**Weight:**  
Almost the  
same as  
aluminum



**Fire  
protection:**  
Enclosure is  
heat resistant  
all-around



**Sustainability:**  
Around 50%  
less CO<sub>2</sub>  
emissions  
compared to  
aluminum



**In the event of a fire,  
the battery housing must  
protect all passengers.  
This is why thyssenkrupp  
Steel has made this  
a key priority of the  
selectrify® initiative.**

project engineer Andreas Breidenbach puts it like this: “Steel is indispensable in generators, transformers, and electric motors. And it is the material of choice when it comes to body construction, battery housings, and chassis solutions. Our selectrify® initiative is taking electromobility in the right direction.”

### **The selectrify® reference structure and a new mission**

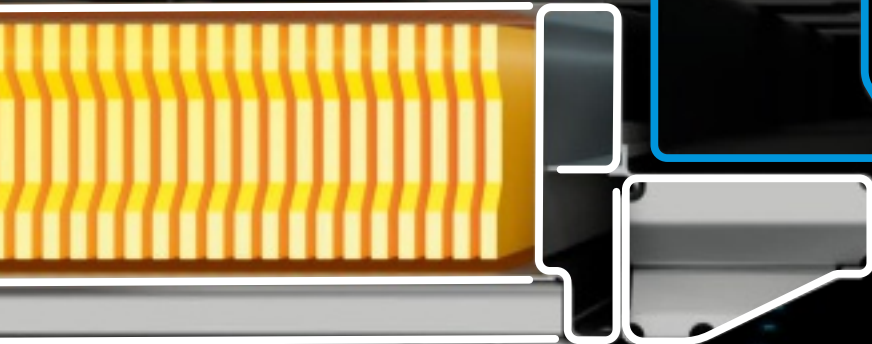
The so-called reference structure is the key pillar of selectrify®. “We deliberately started off with a blank sheet of paper to

put any preconceptions aside and develop an economical concept for the body of a weight-optimized and safe electric vehicle that is suitable for large series production,” continues Breidenbach.

The wealth of knowledge about new design paradigms is impressive. For instance, a large underfloor battery and the compact design of an electric drive system results in longer wheelbases, shorter overhangs, and altered load paths in the event of a frontal crash.

This opens up new possibilities for vehicle design and encourages a shift from >

The selectrify® battery housing reliably protects the most sensitive and costly component.



High-strength steel with a thickness of just 1.2 mm protects the battery despite little deformation space in the event of a collision with foreign bodies from below.

› complex geometries to simpler structural components and profiles. At the same time, the structural requirements for the rocker and B-pillar are increasing in order to provide optimum protection for the battery in a lateral crash. The reference structure takes into account a wide range of requirements and thus sets the stage for creating a solid solution. Breidenbach: “Naturally, we have no intention of building electric cars ourselves. But our virtual selectrify® reference structure combines safety, comfort, range, and costs in way that delivers optimized design options for electric cars. This ensures that any insights into new requirements are considered when developing new materials for our customers.”

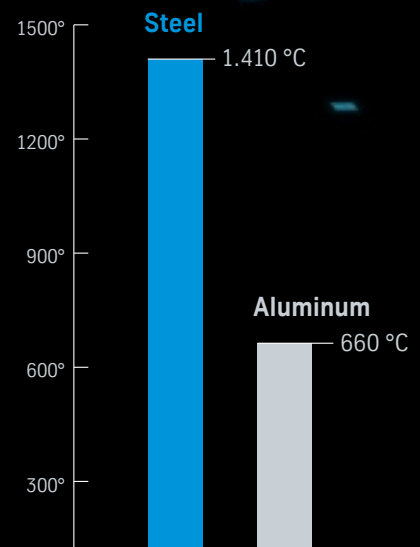
### Decisive component: Battery housing

The battery housing was identified as the key element early on. Previously, the vehicle safety concept served the main purpose of providing the best possible protection for passengers. Now the protection of the drive

battery is another key objective. “Our aim was to develop crash and intrusion protection for the most sensitive and expensive component of electric vehicles, namely the battery system including cells, management, and thermal management. What made this task so difficult was that we had additionally set out to gain superior properties in terms of economy, installation space economy, electromagnetic shielding, and fire protection,” says Daniel Nierhoff.

All of this is important because the battery casing must protect the passengers in the event of a fire. If the drive battery is deformed and thus impaired during an accident, things can get dangerous. In the worst-case scenario, the battery can overheat due to self-amplifying heat (thermal runaway). If a battery goes haywire in this manner, this can result in a fire or even an explosion due to overpressure.

The lateral impact of a pole is therefore of particular importance when evaluating the crash behavior of modern electric cars. This



The higher melting point of steel offers considerable safety reserves: For steel (0.8 mm) it is around 1,410° C. In fire tests performed on the lid of the battery casing, even after 20 minutes temperatures barely exceeded 1,000° C. Aluminum with a wall thickness of 1.1 mm reaches its softening temperature of approx. 610° C after a mere 15 seconds, resulting in material failure after 32 seconds.



The multi-chamber profiles made from high-strength steels absorb very high loads in side-on collisions and prevent the housing parts from coming into contact with the battery modules.

is because the lateral deformation space is smaller than that at the rear or front. In short, lateral impact is the Achilles' heel of electric vehicles. The selectrify® battery housing features help to protect this weak spot: If a lateral crash occurs, multi-chamber profiles made of high-strength steels absorb very high loads and prevent housing parts from coming into contact with the battery modules. Moreover, high-strength steel with a thickness of just 1.2 mm protects the battery despite limited deformation space in the event of impact with foreign bodies from below.

### Steel is the no. 1 in fire protection

If a fire cannot be prevented despite the high level of crash safety, steel offers a decisive safety advantage over other materials. Materials specialist Nierhoff explains: "When performing tests for the 'fire inside the housing' scenario on the 0.8-mm steel cover plate, even after 20 minutes the temperatures we measured rarely exceeded 1,000° C. The softening point of steels normally used in this area is 1,410° C. This means that they offer a considerable safety reserve." Commonly used aluminum sheets have softening temperatures of about 610° C, which is significantly lower than the temperatures they need to withstand. "A sheet with a thickness of 1.1 mm failed after 32 seconds,

suffering a burn-through. In contrast to a steel cover, aluminum therefore requires costly and space-intensive additional measures to achieve the same safety level," Nierhoff continues.

### High performance that is highly affordable

The production of electric cars must become more cost effective to make them more generally appealing. The selectrify® battery housing helps to achieve this goal.

No other component offers similar potential for reducing costs without compromising performance. "Aluminum can't compete. The cost of our battery housing made of steel is about 50 percent of a traditional aluminum component. This figure is based on a scenario with 200,000 vehicles produced per year and a service life of seven years. In our calculation, we have taken into account material and manufacturing costs, tool investments for component production, body-in-white production, and leak testing as well as corrosion protection for steel," concludes Nierhoff.

### Emissions according to life cycle assessment

The CO<sub>2</sub> emissions generated by a vehicle component over its entire life cycle – i.e., from production to disposal – are becoming increasingly important. In the case of electric vehicles, the production stage is of particular interest. As Nierhoff explains, "The production of a steel battery casing generates up to two thirds fewer greenhouse gas emissions than the aluminum reference product. And because battery housings made of steel or aluminum are virtually identical in terms of their CO<sub>2</sub> emissions during use, CO<sub>2</sub> savings of around 50 percent\* can be achieved over the entire life cycle when opting for steel."

The application engineer is proud of the result this comparison of concepts yielded: "Our selectrify® battery housing performs impressively. Thanks to a wide range of patented designs, we are able to meet all requirements with a product that weighs roughly the same as aluminum, while offering superior capabilities in key areas. This proves that steel is the most economical material for battery housings in large-scale production.

### Contact

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### A whole new approach: Extinguishing fires in electric cars

Extinguishing electric cars poses fundamentally different problems for fire brigades than putting out fires in conventional vehicles. For example, it takes more water to extinguish an electric car as the liquid has to be introduced directly into the battery. This may require up to 3,000 liters of water. In a normal vehicle fire, several hundred liters of water are sufficient. However, a standard-issue fire engine only holds about 1,600 liters of water.

Also, the removal of a burnt-out electric car can be tricky as there is a risk that the battery has only been extinguished on the outside but is still active inside. If the battery installed in the burnt-out vehicle is not cooled for a sufficiently long time, the chemical process can cause yet another fire. However, after 24 hours at the very latest, the battery no longer poses a risk.

\* Applies to a total mileage of 150,000 km and the use of primary aluminum (EU consumption mix) for production and the EU electricity mix (2019) during operation

# Hot forming excellence for you

thyssenkrupp Steel offers a comprehensive portfolio of materials for **automotive hot forming** applications and process know-how to support the cost-effective lightweight construction of complex, safety-relevant structural components.

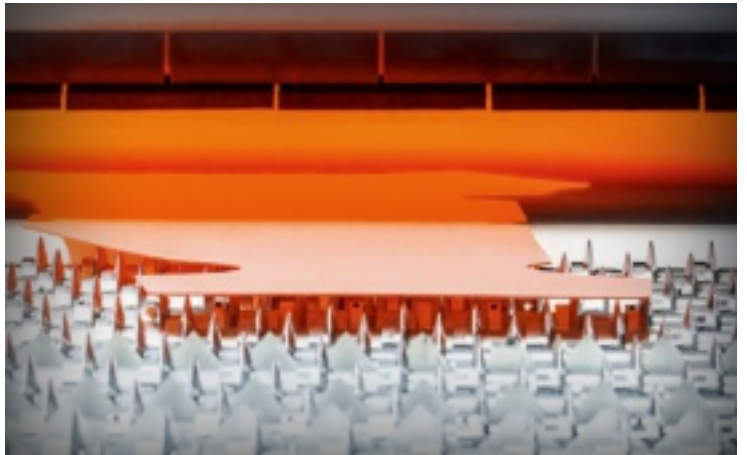
**Text** Sabine Pollmeier

**H**ot forming offers enormous potential for making vehicles lighter and reducing construction costs. In the context of electromobility, lightweight structural design is a highly relevant strategy to reduce vehicle weight. In order to meet increased requirements regarding crash safety and weight reduction while not compromising on stiffness, the vehicle structure must be produced utilizing fewer components and significantly lower material thicknesses. Press-hardenable manganese-boron steels are ideally suited for these types of car body components because they allow significantly higher component complexity and offer maximum strength after hot stamping.

thyssenkrupp Steel offers hot-rolled, cold-rolled, and AS-coated MBW® manganese-boron steels for hot forming. The new AS Pro coating ensures significantly increased process and component safety in vehicle construction. It also helps to reduce energy consumption in the long term, bringing added economy to series production. Thanks to the innovative alloy concept of AS Pro, fewer amounts of diffusible hydrogen penetrate the material. This significantly reduces the risk of hydrogen-induced cracking, which can occur in the body-in-white as a result of an unfavorable combination of strength and stress together with critical hydrogen levels. Owing to these properties, AS Pro also offers enormous potential for future safety-relevant components that need to satisfy extreme strength requirements.

## Wide range of hot forming steels

thyssenkrupp Steel offers manganese-boron steels for hot forming in the strength range from 500 to 2,000 MPa after press hardening. The two AS-coated grades MBW® 500 and



Thanks to our materials and process expertise as well as tailored services, thyssenkrupp Steel is a strong partner for hot forming in the field of automotive engineering.







**Comprehensive hot forming consultation:** from the selection of materials and processes to the feasibility analysis of forming technology and component design.

### Ask the experts!

**Our tailor-made services** for hot forming include:

- Analytical characterization
- Material characterization
- Process and application simulation
- Processing support including the determination of diffusible hydrogen using the proven TDMS analysis method
- On-site training
- Troubleshooting

MBW® 600 are ideal for tailor-made blanks, providing components with the extreme strength and ductility required to withstand the stresses associated with the application. The coated standard hot forming grade MBW® 1500 is characterized by a high resistance to deformation, making it ideally suited for safety-relevant components used in the passenger compartment. The portfolio is rounded out by the MBW® 1200 grade, which is also AS coated. The new steel grade impresses with its good spot weld performance in the event of a crash, which does away with the need for cost-intensive tempering in the flange area. On top of that, MBW® 1200 meets higher ductility requirements. The bending angle has been significantly increased compared to MBW® 1500. Thanks to an increased strength of up to 2,000 MPa following hot forming, MBW-K® 1900 is perfect for further reducing weight. The grade offers high resistance to deformation in the event of a crash and is used in bumpers, side impact beams, or laterally loaded cross beams.

### Custom hot forming

thyssenkrupp Steel's proven and patented process for hot forming – called tailored tempering – offers the possibility of creating monolithic parts with strength and elongation properties that differ on a local level. Customers stand to benefit in various ways, including a reduction in process steps because different part properties can be set in a single operation and reproduced

with precision. The resulting reduction in materials translates into less weight despite an excellent crash performance.

### Optimizing series production

As a hot forming expert, thyssenkrupp Steel has extensive process know-how and offers not only material concepts and surfaces, but also services that help customers determine the ideal parameters for hot forming. We have a test facility that can be used towards this purpose by mapping the processes used in volume production on a laboratory scale. These analysis services in and for the pressing plant provide partners with comprehensive support for vehicle development, from component design through to production readiness. In addition, the process, component feasibility, and microstructure can be investigated using FEM simulations at thyssenkrupp Steel.

### Web

Link to more information on hot forming steels:  
[www.thyssenkrupp-steel.com/en/hotformingsteel](http://www.thyssenkrupp-steel.com/en/hotformingsteel)

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# Working together to push the boundaries of safety

In a joint project, thyssenkrupp Steel and KIRCHHOFF Automotive tested the use of high-strength hot forming steels in **crash management systems**. The resulting component is a cross beam with a material strength of around 2,000 MPa that delivers outstanding crash performance, even though it is both lighter and can be produced more cost efficiently than the reference.

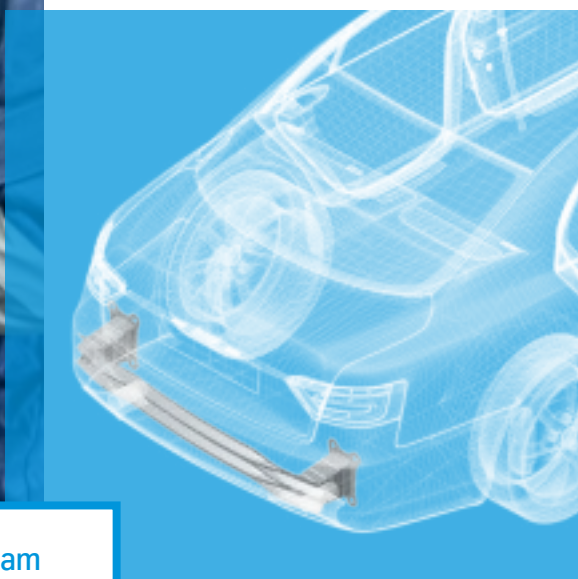
**Text** Christiane Hoch-Baumann

**T**he innovative crash management system from automotive supplier KIRCHHOFF Automotive, which was developed together with thyssenkrupp Steel, is very light and cost effective. The crash management system generally comprises a bending crossmember, two crash boxes, and bolt-on plates that connect the system to the body. Bending cross beams made of steel are usually designed in two parts: a shell and a strike plate designed as a closed profile.

The aim of the project was to develop a particularly lightweight, crash-proof, and cost-effective system that still delivers high torsional stiffness. After both project partners had developed the concept and KIRCHHOFF Automotive implemented the design, thyssenkrupp Steel assisted KIRCHHOFF Automotive in working out the process design and performed initial forming tests. “We decided on creating the bending cross beam using hot forming,” says Rolf Röttger, Senior Engineer Crash at thyssenkrupp Steel in explanation of the development approach. “To streamline the



Two companies, one goal: to produce a lighter and more cost-effective solution compared to conventional crash management systems. The project team made up of specialists from thyssenkrupp Steel (from left to right: Rolf Röttger, Melanie Dinter, and Dr. Stéphane Graff) and KIRCHHOFF Automotive (second from left: Lena Kremer) succeeded in achieving their objective with an innovative bending cross beam made from MBW-K®1900 hot forming steel.



### Cross beam with new geometry

In the area where the component is connected to the crash box, the crossbeam profile opens outwards, and in the middle it opens inwards. This design enables the connection of longer crash boxes, allowing the system to absorb more energy.

This changing direction of where the component opens makes the profile more resistant to torsion."

The absence of a strike plate also reduces weight, material, and process costs.

process, we optimized the geometry of the crash management system."

### High strength and good formability

As regards the material, the decision was made in favor of the high-strength, uncoated MBW-K® 1900 hot forming steel – a lightweight construction material that KIRCHHOFF Automotive is already using in series production. "The MBW-K® 1900 hot forming steel is ideal for this purpose," says Melanie Dinter, Senior Engineer at thyssenkrupp Steel's customer service. "In addition to the advantages for the crash concept, hot forming steel allow us to realize very complex geometries."

Dr. Stéphane Graff, Senior Engineer for hot forming at the steel manufacturer, explains why: "Like all hot forming grades, the MBW-K® 1900 has excellent formability at the high temperatures of around 800° C that exist in the press die. Also, thanks to its low yield strength and tensile strength in the hot state, it can be formed with significantly reduced press forces. Thanks to its strength of up to 2,000 megapascals after press hardening,

MBW-K® 1900 offers an even greater potential for lightweight construction than our classic hot forming grade MBW® 1500 as it allows manufacturers to further reduce the sheet thickness."

The construction of the prototype tool and the pressure tests took place at automotive supplier KIRCHHOFF Automotive in Attendorn. "In the case of the bending cross beam, what made the forming process challenging was the special geometry, which is characterized by several shafts along the height of the component as well as interlocking shafts along its longitudinal axis," says Lena Kremer, Advanced Product Development Specialist at KIRCHHOFF Automotive. "The special feature of our bending cross beam concept is that the direction in which the profile opens changes across its length. The profile opens inwards in the center, which has a positive effect on the deflection of the cross beam. The profile opens outwards at the edges. This, in turn, increases the length of the crash boxes connected here and thus allows more energy to be absorbed. At the same time, the open, wave-shaped profile has a high torsional resistance."

### Successful development in a spirit of partnership

The properties of the MBW-K 1900 hot forming steel speak for themselves: Press-hardened steel delivers the same crash performance of the overall system, the material is more malleable, and its use results in a weight reduction of almost 20 percent compared to the reference design. At the same time, costs are reduced by around eight percent. "In addition," adds Kremer, "the initial force peak can be calibrated by performing local length adjustments and thanks to the fact that the crash box is directly connected to the bending cross beam."

KIRCHHOFF Automotive's innovative crash management system meets all predefined reference requirements. Melanie Dinter elaborates: "Together, we have developed an innovative bending cross beam design which, in combination with the outstanding strength of our hot forming-capable steels, offers many advantages. Such a success can only be achieved if the partners define clear roles and interfaces. We communicated closely and exchanged information throughout the project. This included refreshing our knowledge in workshops and via digital platforms." A real-life crash test using the component is soon to be carried out. This will be complemented by towing tests and a quasi-static three-point bending test.

### Contact

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# Steel for an extraordinary frame

What do cyclists expect from a professional racing bicycle? How does it need to be designed to make them want to keep racing on forever? The **steelworks** project team came up with an answer to these questions.

Text Maike Liess

**P**eter Krins is 33 years old and an expert for process optimization in Logistics at thyssenkrupp Steel. He has also been a triathlete for the last ten years. Performance is what counts most for him in a competition. At first, he would never have thought that a steel frame could compete with conventional racing bikes made of carbon or aluminum. "Riding the steelworks was a completely new experience for me," he admits. He had the chance to do so during a five-day test ride with a team of six colleagues who are equally enthusiastic about cycling. Firm ground, gravel, pavement, asphalt – the cyclists put the bike to the test in a broad range of environments. This allowed the amateurs to understand the end customers' point of view and capitalize on these insights to design a better steelworks prototype.

The test riders covered over 1,000 kilometers and visited various thyssenkrupp locations. They started out in Duisburg and went all the way to Amsterdam via Andernach and then back again. The cyclists found that the strengths of steelworks really come into their own on longer distances and when riding along straight roads. "If you still feel fine after nearly a week of cycling, this says a lot about the comfort of the bike." The team also discussed their suggestions for improvement with project manager Jia-Uei Chan. Based on their feedback, a new fork and a modified chain ring have been introduced to optimize performance.

## The Silicon Valley of steel processing

A lot of effort went into designing the special features of the steelworks. The project team brought together experts who skillfully exploited all the advantages of the material. This included the automotive supplier for complex metal and hybrid structures, KIRCHHOFF Automotive, the experts

## Award-winning quality

**steelworks** is a racing bike that shows off all the advantages of steel: It is robust, extremely light, and elastic for that special riding comfort. However, it is uncompromisingly rigid in the bottom bracket area to ensure that the rider's power is transferred into forward momentum with maximum efficiency. This bicycle is now **being produced in series**. It's so beautiful and elegant that it was awarded the **Best of the Best Red Dot Design Award** in the Material & Surfaces category. **steelworks** also won over the editorial team of **RoadBIKE-Faszination Rennrad**, who tested it this summer and gave it a very high rating. It therefore does not come as a surprise that many satisfied buyers are already taking to the road with it. Would you like to join them? This is where you can purchase the racing bike online: [www.steelworks.bike](http://www.steelworks.bike)



reddot design award  
best of the best 2019





for jig and fixture construction and laser welding technology, Bergmann & Steffen, 3D laser cutting and welding specialist Hujer Lasertechnik, and a few more. Uwe Bergmann sums it up: “The Ruhr region is like a Silicon Valley for steel.”

### Making steel's DNA tangible

In the German cradle of the steel industry, nothing is deemed impossible, including the implementation of a highly complex design idea: “Steelworks is based on an organic design into which we have infused the DNA of steel,” enthuses Jia-Uei Chan. This is achieved with the high-strength DP-K® dual-phase steel, which is ideal for cold forming with a high degree of stretch-drawing. Prototype Workshop Manager Marcus Bruse from KIRCHHOFF Automotive points out further advantages of the material: “Steel can be used in vehicle construction in a cost-effective and versatile manner. High-strength steel is the material of the future, especially when it comes to lightweight construction. For the racing bike, we pressed a 0.7 millimeter thin, high-strength dual-phase steel into two half-shells in a deep-drawing process.

In the course of the project, a number of simulations and tool optimizations were necessary to achieve an optimal result: “The success of this project is owing to the competence and experience of the engineers of both companies



**Technology, good ideas, and teamwork: Project manager Jia-Uei Chan and designer Ralf Stegmeyer have succeeded in producing a unique racing bike together with strong partners.**

as well as excellent collaboration,” says Bruse. In the next step, the two half-shells were prepared for laser welding. At Bergmann & Steffen, they were given so-called dimples. These tiny nubs on the welding flanges were added to create channels for the zinc to escape. This was necessary because zinc becomes gaseous at a lower temperature than steel. “This procedure prevented vaporized zinc from getting trapped in the seam,” explains Bergmann.

Clamped in a special fixture, the half-shells were shipped to Hujer Lasertechnik. This is where the two parts were “married.” All which remains to testify to this joining is a hardly visible weld seam. “Time and again, other experts told us that our project was doomed to failure,” says designer Ralf Stegmeyer. “We proved them wrong.”

# Hot-rolled strip keeps things rolling

Excellent processing characteristics and good performance: thyssenkrupp Steel supplies a comprehensive portfolio of hot-rolled steels for the cost-effective lightweight construction of **high-strength chassis parts** – for today's vehicles and those of the future.

Text Sabine Pollmeier

In times where vehicles are putting on weight again, lightweight construction remains a key driver, and the chassis is no exception. There are many ways to reduce weight using hot-rolled products, be it high-strength multiphase steels or substituting solid materials with precision steel tubes. thyssenkrupp Steel provides its customers with a comprehensive hot-rolled product range for any application: manganese-boron steels for precision steel tubes, soft steels, structural steels, as well as micro-alloyed fine-grain steels and high-strength multiphase steels. They are available as uncoated and coated hot-rolled wide strip or slit strip and as uncoated precidur® precision strip.

## Standard – soft steels, micro-alloyed fine-grained structural steels and structural steels

Uncoated, hot-rolled, soft steels and unalloyed structural steels enable cost-effective chassis solutions for simple geometries. Structural steels are generally used in wheels and in the steering system. Soft steels, on the other hand, are used in the various brackets for fastening componentssuch as shock absorbers.

In the area of the axles – axle beam, transverse and longitudinal control arms – our perform® grades are usually used as low-/micro-alloyed fine-grained structural steels with yield strengths from 355 to 420 MPa. The high-strength perform® grades from 500 to 700 MPa are ideal for shaving off some kilos by reducing the sheet thickness. All micro-alloyed grades are also available as standard grades S355MC, S420MC, VDA HR340LA, and HR420LA.

## Highly ductile micro-alloyed grades

Whenever significantly improved formability is required for complex component geometries, high-ductility micro-alloyed fine-grain struc-

tural steels are the first choice. They deliver improved formability and have extended hole expansion characteristics. The special micro-structure of the high-ductility grades ensures stable mechanical properties (low scatter, such as with perform® 500 HD), which is critical in ensuring a high production reliability. Low-/micro-alloyed and high-ductility micro-alloyed steels are available as hot-rolled wide strip or as precidur® precision strip with a particularly narrow tolerance.

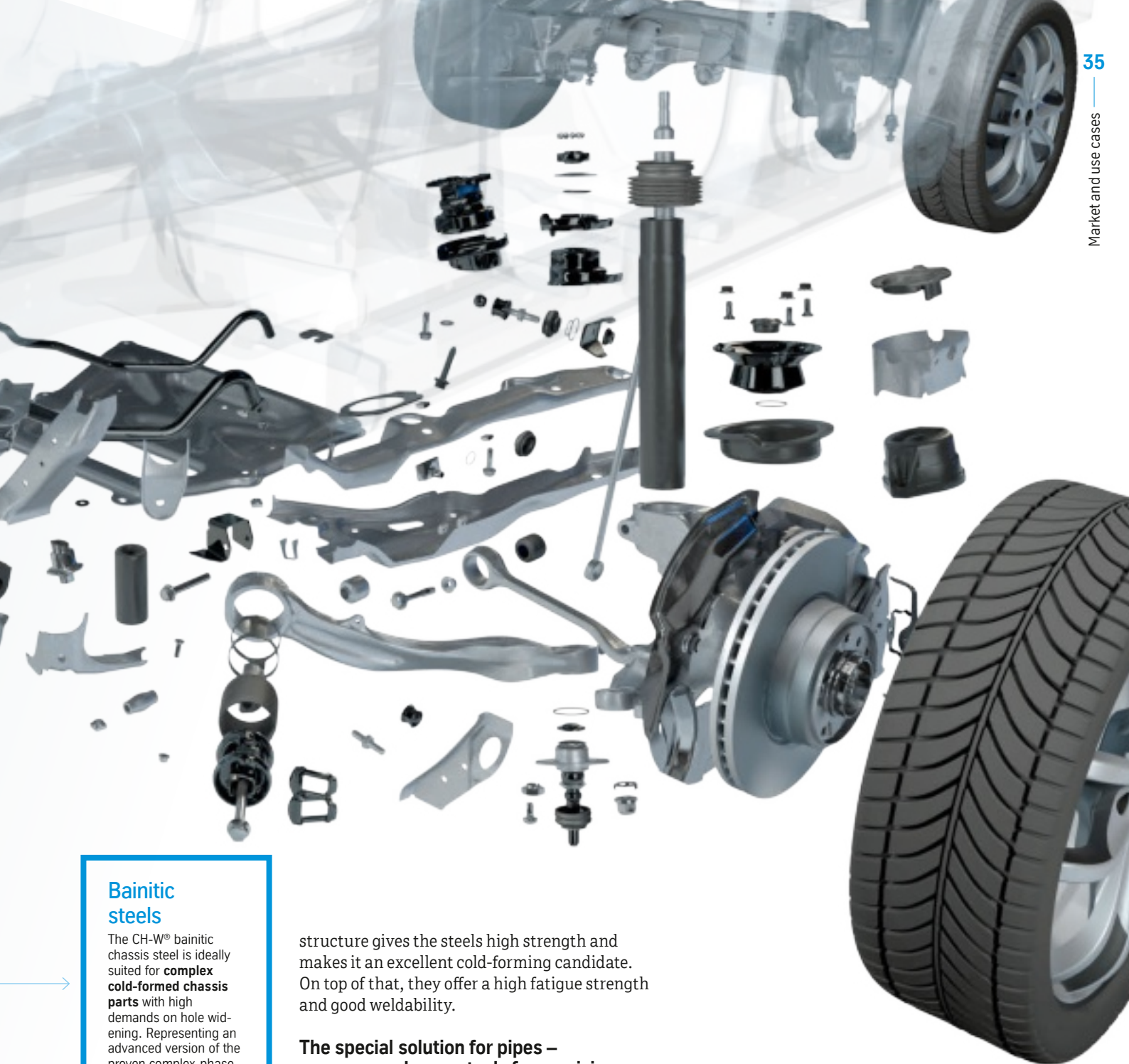
## The lightweight solution – high-strength hot-rolled multiphase steels

Our hot-rolled multiphase steels such as the dual-phase, complex-phase and ferrite-bainite-phase steels FB-W®, the bainitic chassis steel CH-W® 800, and the precidur® HBS precision strip product enable the production of chassis parts with complex geometries that also provide the high strength typically required for traverse control arms. Better yet, they are lighter than conventional high-strength steels.

The DP-W® dual-phase steels have a high strength, a low yield-to-tensile ratio, and superior fatigue strength. They come into their own when used as thick sheet metal since they are characterized by good formability, weldability, and surface quality. DP-W® steels are mainly used in tires.

Compared to DP-W® steels, CP-W® complex-phase steels offer very high strength and yield strength values and are ideally suited for low-weight chassis components. Even slight forming results in significant hardening. CP-W® steels allow for easy cold-forming and welding. They are mainly utilized in the production of axle components and transverse/longitudinal control arms. For applications that require robust, dynamically loaded yet complex chassis components, FB-W® ferrite-bainite phase steels are the first choice. The ferritic bainitic micro-





## Bainitic steels

The CH-W® bainitic chassis steel is ideally suited for **complex cold-formed chassis parts** with high demands on hole widening. Representing an advanced version of the proven complex-phase steels, CH-W® offers a guaranteed hole widening of at least 60 percent, improved elongation at fracture, and a flawless surface, while the other parameters are comparable to those of previous grades. Our CH-W® chassis steel is the lightweight solution for single-shell traverse control arms and similarly demanding components.

The precidur® HBS precision strip products that deliver strengths in the 600 to 1,000 MPa range have a **favorable yield ratio** and are very well suited for critical forming operations, especially those that involve the forming of punched or cut edges.

structure gives the steels high strength and makes it an excellent cold-forming candidate. On top of that, they offer a high fatigue strength and good weldability.

## The special solution for pipes – manganese-boron steels for precision steel pipes

Our application-optimized manganese-boron-steels of the tubor® series are excellently suited for welded, cold-rolled, or drawn precision steel tubes thanks to their excellent forming properties. Precision tubes made of tubor® steels are very strong and can withstand high dynamic stresses. This makes them predestined for use in safety-relevant components such as stabilizers. They are also much more cost efficient and lighter than solid materials.

The material has a homogeneous and fine-grained microstructure with a low sulfur and phosphorus content. Segregation in the microstructure is significantly minimized by means of special process engineering measures. Thanks to optimized production in combination with an analysis tailored to the end application, tubor® steel grades offer higher strength and improved toughness when tempered.

## Web

The link to hot-rolled strip products:  
[www.thyssenkrupp-steel.com/en/hot-strip-in-motion](http://www.thyssenkrupp-steel.com/en/hot-strip-in-motion)

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# Embracing the power of wind

The highly innovative company Enercon is holding its own in the wind energy sector. Part of their success is made possible by **electrical steel and know-how** from thyssenkrupp Steel.

Enercon built the new E-138 EP3 turbine near Amsterdam. A few of these models are now on their way to Canada.



Text Christiane Hoch-Baumann

**J**ust the rotor with an impressive diameter of twelve meters weighs more than 40 tons. It takes a special crane to hoist it into the air. Together with the stator, it forms the core component of the wind turbine. The ring generator converts the power of the wind into rotational energy. Enercon employees assemble the new E-138 EP3 turbine for low-wind operation at a place around 80 kilometers north of Amsterdam. The design is compact, and the entire turbine is optimized in terms of costs, construction, and logistics.

Enercon, headquartered in Aurich, East Frisia, is a true pioneer of the industry. Innovation is in its blood. The fact that the company owns half of all patents in the field of wind energy technology worldwide proves this point. Founded in 1984, the company has been focusing exclusively on gearless turbine technology since 1992. The generators, which form a single unit with the rotor hub, ensure an optimal energy flow and a long service life. "Fewer moving parts save money and protect the environment," says Ralf Mühlenbrock, Managing Director of STA Stanztechnologie Aurich GmbH, which produces electrical steel sheets for generator construction exclusively for ENERCON.

### Recipe for success: Excellence

The East Frisians have been asserting themselves on the wind energy market for decades. The company is growing consistently and sustainably, permanently optimizing their portfolio and processes. As an owner-operated company that started off small, the plan is to expand without relying on investors. The company philosophy in a nutshell: "Having exclusive suppliers is essential for us. They enable us to react flexibly and quickly both to our customers' wishes and internal challenges."

When it comes to the generator, the core component, Aurich has relied on powercore® products from thyssenkrupp Steel for many years. The electrical steel produced in Bochum is used throughout the entire energy supply chain of the electrical engineering process, from the generation of electrical energy in generators to the consumption in electric motors and appliances. This is where powercore® delivers an extremely high degree of efficiency. "The performance of the generators, and with it the efficiency of the entire wind farm, critically depends on its special material properties," explains Thomas Sube, Account Manager for



At the foundry in Georgsheil in the district of Aurich, Enercon recycles steel scrap from generator production. thyssenkrupp Steel helped to make this possible by optimizing the mix of materials used to produce its steel.

Non-Oriented Electrical Steel Application Technology, thyssenkrupp Steel. The properties of the electrical steel were specially optimized for use at Enercon and produced from a custom alloy to ensure higher conductivity and stamping suitability. This is yet another reason for the rise in wind farm efficiency over the past few years.

Important production steps are coordinated within the Enercon network, such as plant component casting and the punching of electrical steel for generator production. Almost half of the cast material used for the production of rotor hubs, machine mounts, or blade adapters is obtained from steel scrap from generator production. The punching scrap generated on the electrical steel strip is collected, melted down, and reused. The process was made possible through close cooperation between Enercon and its longstanding partner in Bochum. The companies worked together to optimize the mix of materials used to produce the electrical steel.

### Addressing a global market

Excellence pays off: The international wind market has its sights set on Aurich. Wind turbines manufactured in East Frisia now operate on a bluff in Brittany, on the gentle slopes of Anatolia, and in the northern Swedish province of North Bothnia. Following a successful test phase in the Netherlands, the new E-138 EP3 is now also being used in onshore projects across the globe.

### From East Frisia to the world

Inspired by the vision of relying 100 percent on renewable energies, Aloys Wobben founded a company for the generation of electricity from wind energy in 1984. This made pioneer Wobben's company one of the first players in this new market. Today, the wind turbine manufacturer Enercon, headquartered in Aurich in East Frisia, directly and indirectly employs more than 12,000 people in over 30 countries. What makes the turbines stand out is their gearless design. More than 30,000 turbines with a combined installed capacity of over 54.5 gigawatts have been installed worldwide to date.

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Carsten Rokitt was in charge of implementing shop floor management at thyssenkrupp Steel. This tool is designed to help managers put a greater focus on customers, as the continuous improvement process becomes part of day-to-day business. To achieve this, managers are encouraged to make the rounds in production, communicate directly and effectively with employees, and coach them instead of lecturing them. This goes a long way towards solving problems in a structured manner.



# With a view to a customer thrill

When thyssenkrupp Steel is in need of pioneering work, it turns to Carsten Rokitt. One such example is the **introduction of shop floor management**, a tool for strengthening the customer focus – and a bit of an outlier in the process industry.

**Text** Tina Henze  
**Photos** Rainer Kaysers  
**Graphics** C3 Visual Lab

Carsten Rokitt is not afraid of venturing into uncharted territory. That's how he describes his work – exploring areas that not many people have touched yet, if any. The great unknown is a dangerous place, and he can't count on everybody's support. Since he started his first job at thyssenkrupp Steel in front of a blast furnace back in 2000, he has been taking on these kinds of positions time and time again, whether as an internal consultant establishing innovative processes at the company or as a constructor of the world's largest cloth filter system. When the division decided to be among the first companies in the process industry to introduce shop floor management, the tall man was ready to get the job done. He now heads the Supply Chain Steering department.

## Face-to-face communication instead of a quick e-mail

That was almost two years ago. On this particular Thursday afternoon, the Head of Production Systems visits the coupled pickling and tandem plant in Dortmund. This is where coils for customers from the automotive industry are further processed, for example. 100 coils customized according to customer requests are produced in each shift. Employees work around the clock, with over 1.9 million tons of steel passing through the plant every year. One core principle of shop floor management is to be a manager who is present onsite and see what's going on for yourself, rather than just writing e-mails and arranging meetings. That means it's only logical for Rokitt to take a look at how the

Photo: thyssenkrupp steel Europe photography

A photo from pre-pandemic times: Patrick Rau (right) regularly convenes with his employees to compare the target and actual status. Back then, facial masks were just not part of the picture, and neither was social distancing.



› principle he has introduced to production has been adopted, while five rolling stands are each applying up to 3,300 tons of pressure on steel sheet a short distance away. He observes how shift coordinator Patrick Rau schedules communication with his team at about 3 p.m. The entire team congregates at the board for daily meetings held in the morning and afternoon. The hands-on tool visualizes which order is in process, what its objectives are, which processes are being executed, and where there are issues by means of tables, columns, and figures – in other words, it provides information on production and its tasks at a glance. “If the board is well maintained, I know that the processes have become habitualized,” says Rokitt. The board is one of these rare instances when a tool that is supposed to change production in a sustainable way is actually visible. The core goal – the direct, transparent, and effective communication of the manager – tends to unfold its effect in an unseen manner. Shift coordinator Rau has

experienced this effect firsthand: “Shop floor management has changed how we go about our daily work here in Dortmund over the past few months – and it has improved things.” Problems are being solved in a more sustainable way “because we put down in writing who is supposed to perform what tasks and regularly check whether these targets have been achieved,” he points out. “If a mistake occurs repeatedly, we can track the cause in a more structured way than before.” This makes processes clearer, more efficient, and results in better quality. It also has positive effects on occupational safety. And that is a top priority, says Rau.

### New management culture

Integrating a management tool into the daily work routine requires a great deal of staying power. Shop floor management was tested and finetuned at six training sites for a good year before being rolled out to business units at all plants by the beginning of 2020. 2,000





## Excellent management and processes

**Shop floor management** is a key component of production systems at thyssenkrupp Steel. Its objective is to boost value creation and minimize losses in order to continuously improve on important issues such as overproduction, errors and reworking, and transit times.

# 2,000

**managers** from all production departments and production-adjacent operations at the steel manufacturer have been trained to date.

managers have undergone training, while 430 boards have now been installed in production departments as well as in production-relevant operations. Now it's time to consolidate those principles, or, as Rokitt puts it: "The managers have passed their driving test, now it's time for daily driving practice." This isn't always easy because "it's about nothing less than a new management culture," says the manager, before adding, "it's an ongoing process that never ends." If an error occurs, then we don't try to find the "culprit" but work out a solution instead. Managers don't lecture, they coach. In the words of the top manager, "In the past, the best specialist was given a management position; now we empower managers to lead even better."

Shop floor management is closely linked with the continuous improvement process, which aims to make things better day by day to ensure that thyssenkrupp Steel remains a strong competitor and manufactures products that



"We are establishing a new management culture – and it's an ongoing process that never truly ends."

A team of 15 is in charge of implementing shop floor management at thyssenkrupp Steel. The management tool closely interlinks with the continuous improvement process. CIP manager **Sebastian Stronski** (left) and the respective CIP managers of the business units assisted the team with the introduction of the tool.

satisfy every customer, no matter how demanding. Customers in the automotive industry in particular – who know firsthand what shop floor management can achieve – have welcomed this initiative.

The expansion plans also underscore the success of the project. The principle will be extended to administration, while the processes are to be digitized. The latter, in particular, is an enormous undertaking. After all, the 15 team members responsible for implementation will once again be breaking new ground. If shop floor management is still a novelty in the process industry, then its digitized equivalent is even more so. The need to venture into the unknown won't subside any time soon – but pioneers are ready for whatever comes next.

## Contacts

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# Custom lightweight construction

High strength, good forming and processing properties, and improved crash safety: thyssenkrupp Steel's extensive range of **cold-rolled multiphase steels for cold forming** meets the requirements of the automotive industry.



# 2

## Grades that deliver higher yield strengths

For applications that depend on reliable intrusion protection in the event of lateral impacts, grades with increased yield strength such as DP-K® 700Y980T and CP-K® 900Y1180T offer the necessary deformation resistance.

They have superior local forming properties and offer a high hole expansion capability as well as excellent edge stability. Also, in addition to typical body applications, the grades with a higher yield strength are also ideal for interior components when used as uncoated cold-rolled strip.

# 1

## Proven grades

High-strength dual-phase steels are characterized by good cold-forming properties, a high energy absorption capacity, and high deformation resistance – in short, they are ideal for achieving weight reduction in the car body. Classic grades such as DP-K® 330Y590T and DP-K® 440Y780T are therefore proven solutions for use in longitudinal and cross beams and in the roof frame, offering a balanced mix of properties that cater to a broad range of applications.



High-strength dual-phase steels make up an important part of our tailored portfolio for modern lightweight automotive construction.”

Dr. Patrick Kuhn, Product Management

Multiphase  
steels for the  
vehicle body





# 3

## Grades that deliver higher elongation at fracture

The main feature of dual-phase steels with increased elongation at fracture such as DP-K® 330Y590T DH and DP-K® 440Y780T DH is their global forming capacity. Their reserves in elongation at fracture meet the increasing demands on the formability of complex components and ensure process stability in the pressing plant. Compared with the classic grades, these steels offer substantial potential for higher-strength lightweight construction and complex component geometries with challenging forming requirements characterized by high deep-drawing or stretch-drawing percentages.

## Strong appeal: Third-generation AHSS

Multiphase steels that deliver increased ductility in the 1,000 and 1,200 MPa strength classes are currently under development. They combine good local and global forming properties. Their high elongation at fracture as well as a good hole expansion capability and high resistance to edge failure allow for more complex component geometries with pronounced deep-drawing and stretch-drawing design components. This opens up new potential for reducing production costs and weight. These material properties are achieved by introducing a special temperature cycle to our hot-dip galvanizing line. As a result, the steel business of thyssenkrupp now also offers ultra-strong steels of the latest generation with proven hot-dip zinc corrosion protection.

## Web

Her is the link to our modern multiphase steel grades: [www.thyssenkrupp-steel.com/en/dualphase-steel](http://www.thyssenkrupp-steel.com/en/dualphase-steel)

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# When freedom of design meets sustainability

The steel façade awarded the German Façade Prize 2020 exemplifies the versatility of the **pladur® premium product**.

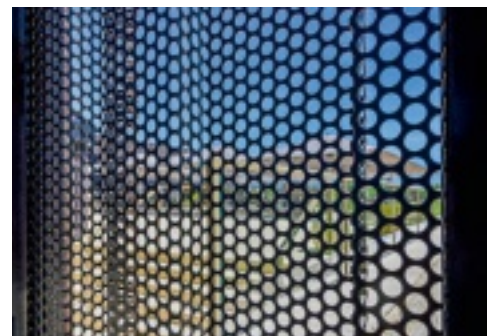
**S**teel construction systems allow for the economical and energy-efficient implementation of building exteriors and set the

stage for designing highly diverse surfaces. A beautiful example of this is the modernized and expanded “Der Öschberghof” hotel, which perfectly blends into the picturesque landscape of the Black Forest thanks to the pladur® coated steel façade from thyssenkrupp Steel. This fall, the architects’ office in charge of the project, “Allmann Sattler Wappner Architekten,” was awarded the German Façade Award 2020 for the project. The “Fachverband für vorgehängte hinterlüftete Fassaden” (FVHF, Trade Association for Ventilated Curtain Walling) has been awarding this prestigious prize for 13 years now. In 2020, the jury had focused on criteria such as “context,” “innovation” and “surprise.”

The “Fachverband für vorgehängte hinterlüftete Fassaden” (FVHF, Trade Association for Ventilated Curtain Walling) has been awarding this prestigious prize for 13 years now. In 2020, the jury had focused on criteria such as “context,” “innovation” and “surprise.”

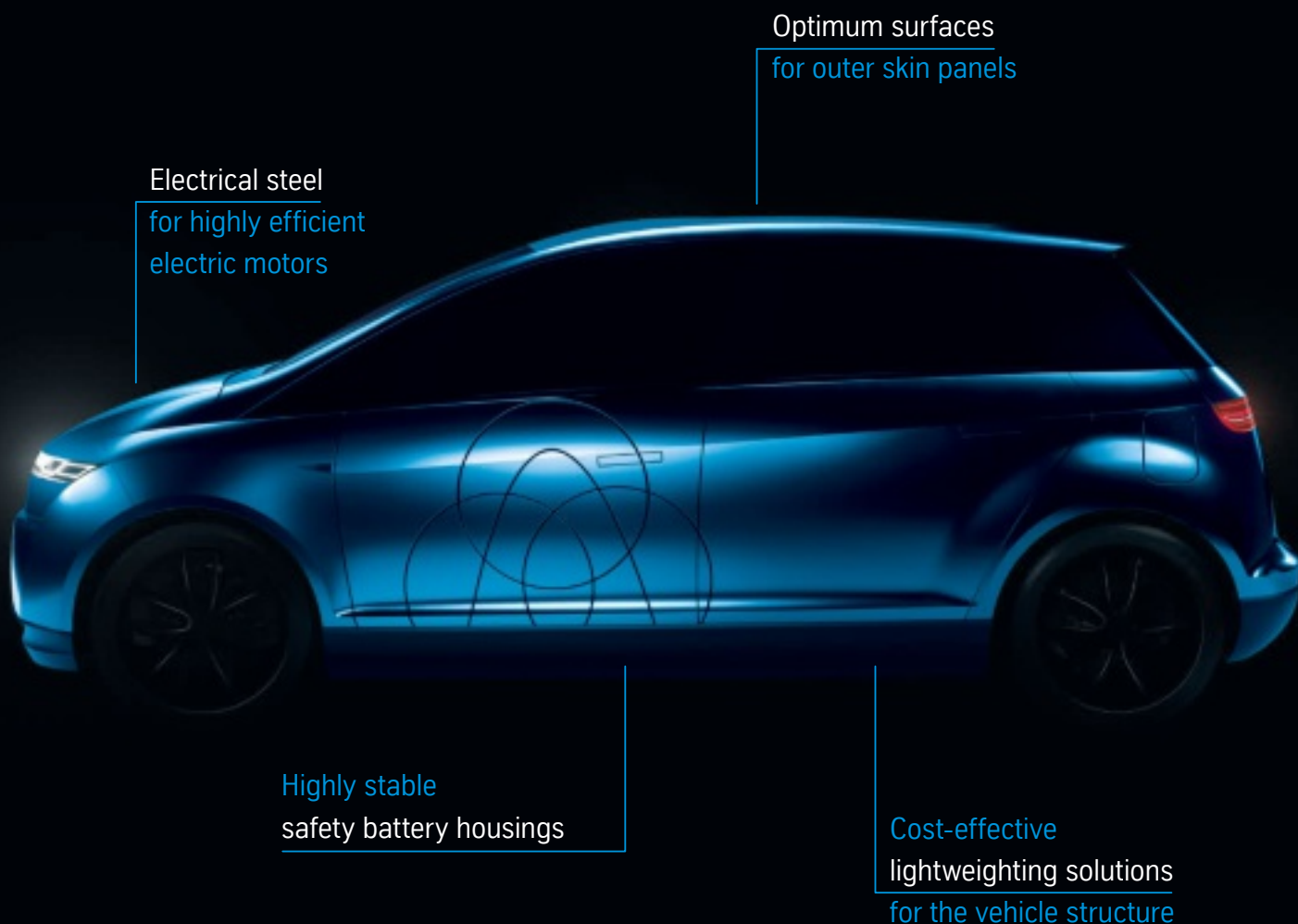
## Infinite recyclability

The award-winning design by “Allmann Sattler Wappner Architekten,” which is conceptually based on the archetype of a Black Forest farmhouse, organically extends the existing recreational facility by adding further gabled roof houses. The eye-catching façade introduces a unifying concept that brings all buildings together. When searching for the right material to use for the new façade, the architects had two key requirements: first, maximum



**Award-winning excellence:** The façade appears opaque from the outside, but some elements allow you to see through them.

freedom of design in implementing their ideas, and second, sustainability, which is a core value of the Donaueschingen-based resort. That’s where the pladur® Relief Icecrystal coil-coated steel from thyssenkrupp Steel came in. Metal-working specialist Arnold AG, the general contractor responsible for the façade design, finally decided on this material. Steel, which can be recycled any number of times, is the ideal material to support a self-sustaining economy. What’s more, it offers excellent corrosion protection properties and is easy to process, which is why even the most demanding forming operations are possible with steel.



Steel:

## The Material of Mobility

Cost-effective lightweight steel solutions  
for the automotive industry

Mobility has many forms - and one material: steel. Whether it's for conventional, hybrid or electric vehicles, steel is indispensable as a cost-effective lightweight material for efficient, safe and climate-friendly automotive solutions. The selectrify® initiative brings together our research and development activities in the field of e-mobility. Because steel is "The Material of Mobility". For more information, visit [www.thyssenkrupp-steel.com/en/selectrify](http://www.thyssenkrupp-steel.com/en/selectrify)

engineering.tomorrow.together.



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