

compact steel

03 / 2014

The ThyssenKrupp Steel Europe customer magazine
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MATERIAL

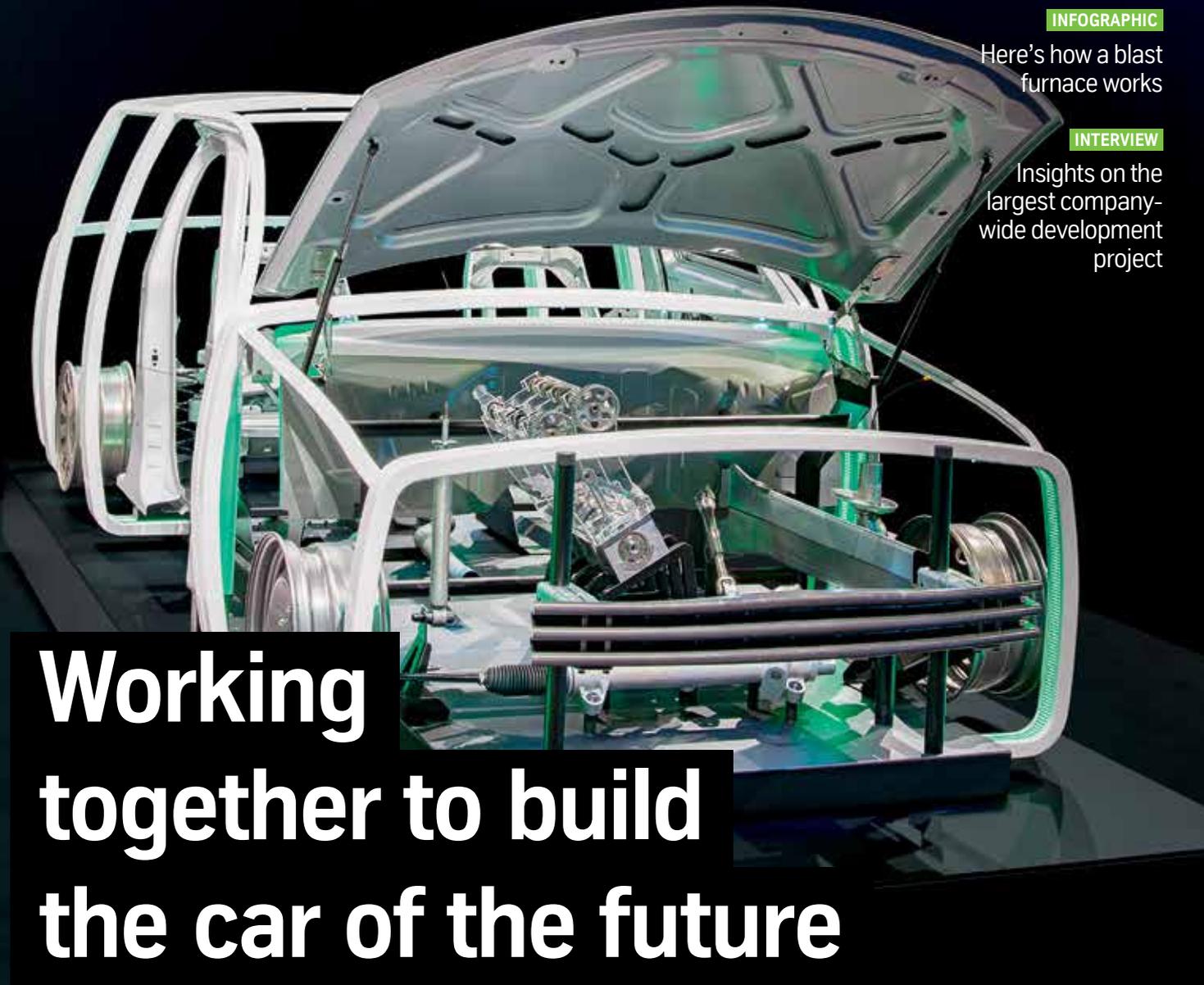
TriBond®
combines different
characteristics in a
single material

INFOGRAPHIC

Here's how a blast
furnace works

INTERVIEW

Insights on the
largest company-
wide development
project



Working together to build the car of the future

Lighter, safer, more efficient – InCar® plus offers 40 improvements
to the powertrain, body, steering system, and chassis

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ThyssenKrupp Steel Europe
Thinking the future of steel



ThyssenKrupp

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A 500-metric-ton crane was needed to load large system components for the modernization work being completed on Blast Furnace 2 in Duisburg-Schwelgern, Germany.



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Major project: InCar® plus comprises 40 different innovations that trump the current standards of the automotive industry in terms of weight, efficiency, and sustainability.



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Dear readers,

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an you still remember your first car? Mine was an orange Beetle that I proudly purchased for 1,100 D-Mark. In the winter, no snow storm could get the best of it, but the heating only worked in the summer.

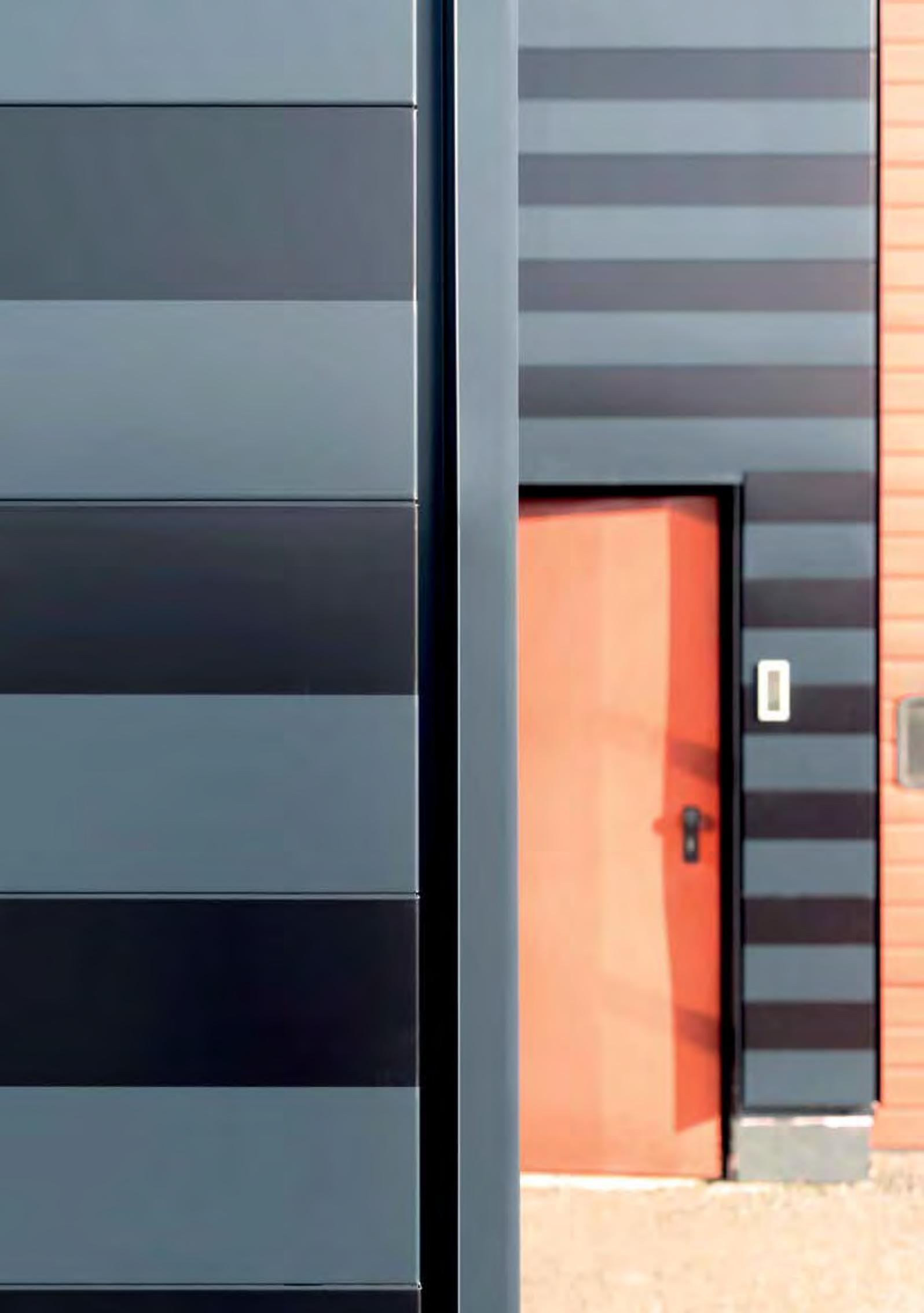
Years later, ABS, catalytic converters, and electronic fuel injection had all become standard features. At that time, I thought that's as good as it gets, but now, as I supervise the largest development project our Group has ever seen, I know that there's always ample room for improvement. And improve we must: The entire automotive industry is faced with some major challenges. Tightening environmental regulations, ever-stricter safety requirements, and the desire for increased comfort are all fuelling rapid advances in technology. With ThyssenKrupp InCar® plus, we are putting some real horsepower on the road – all in the form of an array of brilliant solutions for the car of tomorrow. These solutions include novel approaches and successful developments that help the automotive industry to meet new challenges. See our title story for more information.

The roadshows begin in October. Here, our experts will present you with the fascinating results of our years of research. I am confident that you will find this information interesting and that our presentations will generate new cooperative development projects and contracts. After all, InCar® plus presents excellent solutions for the car of the future. I hope you enjoy reading this issue!

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

Steel earns its stripes

Steel's got style. Prof. Dr. Joan Sofron is to the field of facades what Sir Paul Smith is to the fashion world. Both designers have turned stripes into their personal trademark. To print these stripes onto steel strips, ThyssenKrupp Steel Europe used a special form of the coil-coating procedure. Using this process, it is possible to print just about as many stripes as the customer wants with almost no limits on color. By employing this new stripe pattern, customers can vary the fixed dimensions of the individual elements on their buildings to achieve different effects – for example, fine stripes like a barcode or larger stripes like those of a zebra – depending on the company's individual style and requirements. The PLADUR® coating – a combination of the ZM EcoProtect® flat steel coating and a high-quality paint – ensures that facade elements remain durable and robust. The sample facade in black and anthracite pictured here belongs to the company headquarters of Glasprofi24 in Schloss Holte-Stukenbrock near the German city of Bielefeld. Clothes make the person, eye-catching packaging makes an impression, and attractive facades help to hone a company's image.



It all starts with coils: Coiled sheet metal prior to processing.

Let's talk about sheet metal

In October, the sheet metal processing industry is coming together at the industry's largest specialist trade fair in Hanover.

The EuroBLECH industry trade fair serves as both a barometer for the current economic climate, and a showcase for new technologies. It offers visitors a comprehensive overview of new developments and current trends in the field of sheet metal processing. For entrepreneurs on the lookout for effective machines, intelligent solutions for modern production, or innovative steel materials, all roads lead to EuroBLECH – and ThyssenKrupp Steel Europe will be there too (Hall 17, Booth E33).

"Today, specialist trade fairs are important places to exchange information and network with other professionals," says Jörg Paffrath, Head of Sales Industry at ThyssenKrupp Steel Europe, on behalf of his colleagues in Sales. His department will be represented at the EuroBLECH alongside Sales Automotive, Heavy Plate, ThyssenKrupp Rasselstein, and Hoesch Hohenlimburg. "Trade fairs offer us an opportunity to speak directly with our

customers about the innovative features of our highly specialized products." The EuroBLECH is geared towards specialists in the field of sheet metal processing. From 21–25 October 2014, small, medium-sized, and large companies will meet at the exhibition halls in the capital city of Germany's state of Lower Saxony.

Exhibitors from Germany, as well as from Italy, China, Turkey, and Switzerland will attend, and building international business relationships is the key to long-term success. "It is no longer sufficient to simply present your new materials and products," says Paffrath. "We like to invite representatives to meet with us directly. This makes it easier to understand the standards and expectations held by our customers and innovation partners." The InCar® plus demonstrator has joined the team for this year's trade fair.

Visit www.euroblech.de for detailed information on the event, a current list of exhibitors, information on getting to EuroBLECH, and tips for your visit.

Taking it lightly

Lightweight construction plays a key role in the production of electric vehicles. The LEIKA research project is dedicated to composite car chassis construction – from the development of the materials all the way to production – and the goal of the project is to develop new manufacturing technologies that utilize carbon. At the Dresden location, steel and magnesium sheet with plastic core layers is currently being developed to create a new close-to-production metal-fiber-reinforced plastic (FRP) composite. The project is to be carried out over three years. ■

Top-notch work by the trainees in Dortmund



Beaming winners (from left): Tim Leubecher, Lukas Latussek, and Kai Musielak

Strictly speaking, they are already adults, but because the age limit is set at 21, Lukas Latussek (18), Kai Musielak (18), and Tim Leubecher (20) were eligible to participate in the 'Jugend forscht' youth research contest. The Dortmund-based trainees won the regional and national competition along with the national 'Special Technical Award' for their project, the 'chemical-free self-cleaning doorknob.' They also received initial funding to develop their concept, which uses UV light to sterilize doorknobs. ■



The new blanking line makes it possible: In Mannheim, high-precision work is required.

Giving customers the best cut

The ThyssenKrupp Stahl-Service-Center in Mannheim, Germany, invested around €2.5 million in a modern cut-to-length plant. Now, in addition to producing standard slit strips, the facility can manufacture highly precise custom steel blanks within extremely strict tolerances. Even the smallest dimensions are possible at the highest level of quality, with an array of different packaging options, and most importantly, at a reasonable price. The plant meets the high technical standards of the customers and offers them an additional prefabrication stage. This blanking line has been in operation since August.

Personal care is now on the roster



The shiny, lightweight 'SteeleCare' aerosol can is a welcome addition to the bathroom. This plastic-coated steel can, which is produced by ThyssenKrupp Rasselstein, is not only as good as its aluminum counterpart, it is also cheaper to produce and cuts down on CO₂. This successful design was made possible through the cooperation of machine manufacturers Schuler and Lanico.



New York times: Michael Skorianz in front of the Brooklyn Bridge.

Knowledge opens up new possibilities

Michael Skorianz received a prestigious steel prize for up-and-coming talents in New York

Question: How can we increase yields in iron production while reducing the amount of energy we consume? Dr. Michael Skorianz has an answer to that question, and he has decided to address it in an academic context as part of his doctoral thesis. In this way, ThyssenKrupp Steel Europe employee Skorianz is laying the theoretical groundwork for a new technique that is now used in industrial applications. The impact of this study on the steel industry has already garnered recognition from around the world. As a result, the 32-year-old Austrian won the 'Willy Korf Award for Young Excellence' as part of the Steel Success Strategy Conference held this summer in New York. The annual award is granted to promising up-and-coming scientists who make a significant contribution to iron and steel manufacturing as part of their work. Back in Duisburg, Germany, Skorianz is one of the employees responsible for process development and optimization in the area of steel production.

Willy Korf (1929–1990) is known as 'the steel baron of Baden', and as a steel visionary. He traded in rebar steel, founded a transportation company, and produced rebar mats and steel mesh.



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IT'S BEEN YEARS SINCE

Mikhail Gorbachev visited the Westfalenhütte in Dortmund on 15 June 1989. Around five months before the wall fell, while visiting Germany, he surprisingly agreed to honor an invitation extended by the Works Council.



COR-TEN® IS NOW CALLED PATINAX

The brand license contract with the United States Steel Corporation has expired, and the weatherproof COR-TEN® construction steel is therefore being renamed. The steel material will henceforth be known as PATINAX 355 P and PATINAX 355.

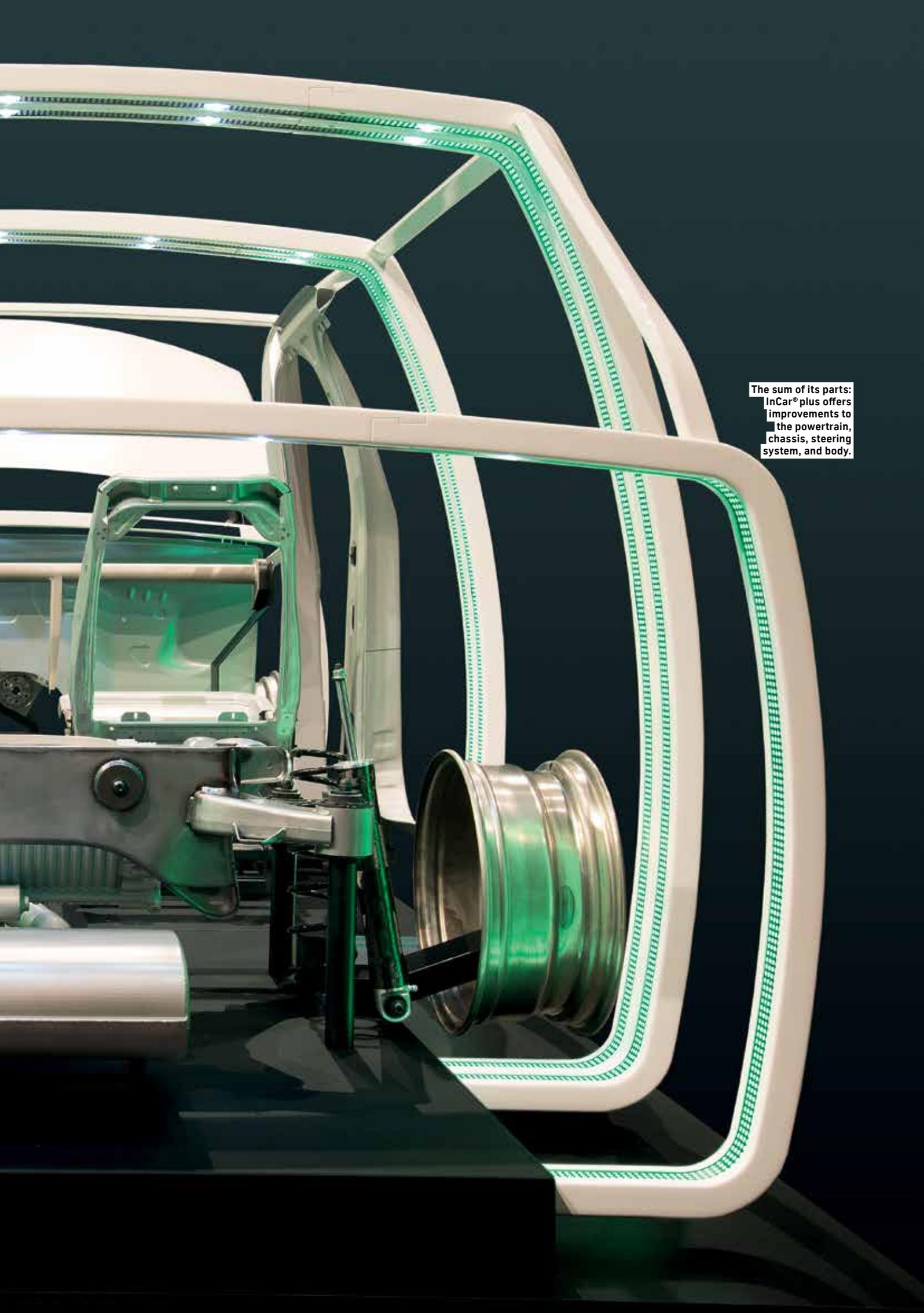


Story

Incredible insights

Companies that want to stay competitive in the automotive industry need new solutions. ThyssenKrupp InCar® plus has got them.

Text: Christiane Hoch-Baumann



The sum of its parts:
InCar[®] plus offers
improvements to
the powertrain,
chassis, steering
system, and body.

The car of the future has to tick a lot of boxes: It has to be more environmentally friendly, more economical, safer, more comfortable – that is, more efficient all around – and on top of that, it has to look good. It also has to be reasonably priced. This presents the automotive industry with enormous challenges.

The large-scale ThyssenKrupp InCar® plus development project offers an array of solutions. The first road shows are set to take place in October. Here, experts will present European customers with over 40 new concepts related to the powertrain, chassis and steering, and body technology. The key word is efficiency, and whether it comes to cost, weight, energy, or performance, all of these solutions represent some significant improvement over the industry standard.

The InCar® plus project incorporates all of the automotive knowledge in the ThyssenKrupp Group. Engineers from the Business Areas Components Technology, Industrial Solutions, and Steel Europe all brought their expertise to bear in the initiative. The fact is networking creates added value. “This project is a testament to our ability to combine different specialist areas and their expertise,” says the group’s CEO Dr. Heinrich Hiesinger. “Research and development are the heart of our company.” The automotive industry represents one of the company’s most important customer groups. Nearly a quarter of ThyssenKrupp’s sales are generated in this sector.

Innovations ripe for the plucking

After three years of intensive work, the results are finally in: innovations and technological solutions that have been tried and tested throughout the entire value chain.

This includes all forming and processing steps involved in the material production, the construction of tools and prototypes, and system assembly for mass production. “Our customers see this comprehensive testing and verification of newly developed solutions as a real advantage,” says Dr. Heribert Fischer, Director of Sales & Innovation at ThyssenKrupp Steel Europe. “This makes the process of integrating our modules and components in serial production operations run as smoothly as possible. To do this, we did a lot of this work in advance and conducted an array of tests.”

This saves the customer valuable time and money – and ThyssenKrupp Components Technology CEO Board Dr. Karsten Kroos sees yet another advantage: “In addition to relying on our ability to

develop new products, our customers expect a high level of quality – most importantly, the product must be robust, durable, and functional. And we have met all of these expectations with InCar® plus.”

Solutions for all areas

In concrete terms, InCar® plus concentrates on three areas: powertrain, chassis and steering, and body. For a powertrain that relies on a combustion engine, the goal is to reduce fuel consumption. “Our aim is to use less fuel, to significantly reduce emissions, and to increase the performance of the engine,” says Subproject Manager Claudius Rath. “For example, it may be possible to use the innovative valve train technology that we have developed to achieve this goal.”

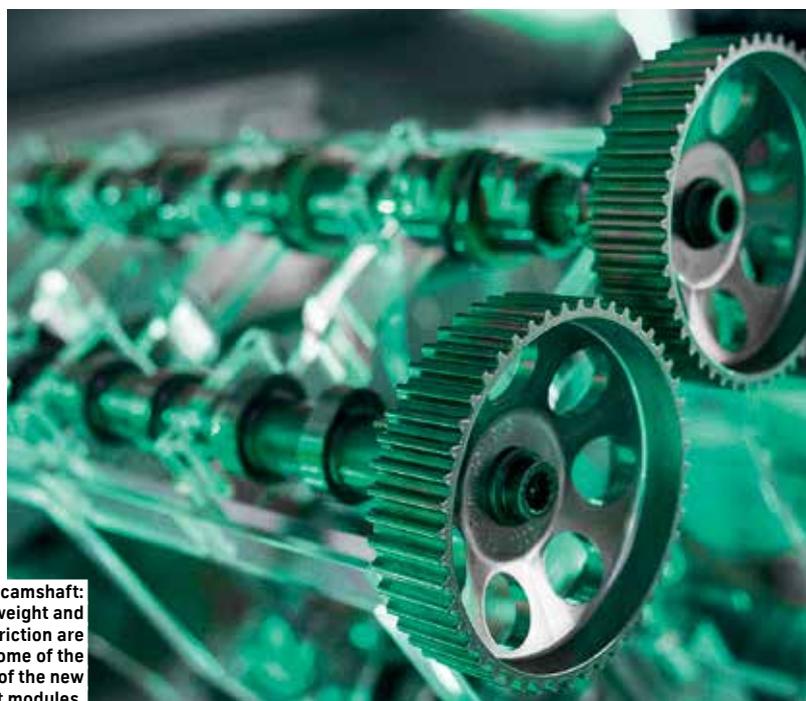
Electric motors are the focus in the area of e-mobility. “We can increase the efficiency of these engines using high-strength electrical steel, which has very strong magnetic and mechanical properties.”

The chassis and steering subproject aims to increase driving safety and comfort. “In addition to developing a fast-switching electrical damping system, we have also introduced a new generation of electrical steering systems,” says Subproject Manager Rainer Pudeg. This enables the use of driving assistance systems such as automatic parking or lane assist. The goal is to develop a more economic design for these steering systems and integrate them into new vehicle classes. Another key element is to combine steel with carbon-fiber-reinforced polymers or aluminum in components such as shock absorber tubes, steering shafts, and steering columns.

“We developed a special manufacturing and assembly procedure for applying these innovations in mass production,” says Pudeg.



The stator, which is made from non-oriented electrical steel, is part of the electric motor.



The perfect camshaft: Reduced weight and valve train friction are just some of the advantages of the new camshaft modules.

Photos: ThyssenKrupp Steel Europe Photography (6)



Three men and their innovative product (from left): executive managers Kroos, Hiesinger, and Fischer in front of the InCar® plus demonstrator.



Many parts make a whole: A look into the demonstrator reveals numerous areas where the InCar® plus project offers new solutions.



Surrounded by fans: The demonstrator with the InCar® plus innovations was the undisputed star of this internal presentation.

More than just good ideas

With InCar® plus, ThyssenKrupp has continued to build upon its comprehensive development project in the area of automotive manufacturing, and in doing so, the company has combined expertise from three different business areas.

Axel Grünekle is the overall coordinator for all individual projects and employees.

Interviewed by: Anke Stachow

How were the ThyssenKrupp InCar® plus projects selected?

Dr. Axel Grünekle: Back in 2010, the Group already had a three-person team – in which I was also involved – tasked with gathering car-related ideas. We evaluated over 100 suggestions based on their potential benefit to customers, the level of innovation required, the chances for economic success, and the compatibility of the idea with our Group strategy. Eight companies at 15 different locations are currently working on the selected projects, which include over 40 individual solutions.

How did you manage all of these projects?

After the organization was established, I met with the managers of all the subprojects and individual projects – body, chassis and steering, and powertrain – every three months. They presented the results of their work, and we discussed and developed new approaches and synergies. We always met at different operation sites so that we could see how our colleagues work and to facilitate knowledge sharing.

So InCar® plus also serves as a means to transfer technology?

Definitely. For example, we developed a significantly lighter steering column made from carbon-fiber-reinforced polymer (CFRP). Carbon Components in Kesselsdorf near Dresden were responsible for the material, ThyssenKrupp Presta in Eschen, Lichtenstein developed the component, and System Engineering in Heilbronn worked on mass production readiness.

Were there ideas that didn't make the cut?

Absolutely. Our managers made it clear that we should regularly check to make sure that the project was moving in the right direction. They insisted that we should not view it as a personal failure if we decided to stop working on a particular development once we had determined that the idea was no longer viable, or if we were not properly addressing the requests of our customers. Being able to make these types of decisions shows good project management skills.

To what extent were you able to use your experiences from the previous InCar® project?

The fact that I was entrusted with the leadership of the entire project certainly had something to do with my experience with the

previous project. I know what it takes to work on company-wide collaborative projects and I maintain close ties with colleagues at different locations. Interpersonal relations are very important in this line of work.

These developments are designed to make cars more efficient. What does that mean?

We can construct lighter-weight vehicles and thereby reduce fuel consumption. We can also manufacture cars that cost less by producing more cost-effectively, for example by eliminating production processes. In addition, by employing new technologies, we can make cars that are more efficient: Over a distance of 100 kilometers, an electrical steering system requires up to half a liter less fuel than a hydraulic steering system. Using lightweight construction, we can manufacture vehicles that are up to 150 kilograms lighter.

What role does sustainability play here?

In the InCar® plus project, we look at the entire balance of energy use: How much energy does it take to produce lightweight materials, and can the car make up for that expenditure by consuming less fuel? Where can we save on materials by recycling? In many areas, steel is a very ecologically responsible material. It fulfills both economic and ecological requirements, and on top of that, steel is an attractive option. All of this makes it a superior choice of material.

The roadshows will put this project through its paces. How long will it take to implement these innovations?

We will market the project heavily for around two years, first in Europe, then in Asia and the Americas. How long it takes to implement individual innovations in cars is dependent upon the complexity of each idea. We have technologies that are ready for mass production today and could be integrated into vehicles almost immediately. On the other hand, we have ideas on the horizon that could take up to ten years to realize.

Axel Grünekle has worked in the Technology and Innovation division for 14 years. From 2005 to 2011, he served as project leader of the 'Body' area for InCar®, and since then, he has worked as overall project leader for InCar® plus.





Claudius Rath is responsible for the powertrain at Components Technology.



Rainer Pudeg from Components Technology is in charge of steering for InCar® plus.



Markus Zörnack at Steel Europe is in charge of developing excellent materials.

Work on the car body is primarily dedicated to economic lightweight construction. “By using new types of steel, innovative sandwich products, and novel processing procedures, such as hot forming of closed profiles, we have been able to meet the increasingly strict demands of our customers for highly functional, cost-effective lightweight construction solutions,” says Subproject Manager Markus Zörnack. Naturally, when developing these solutions, the engineers must make sure not to compromise the safety of the passengers. With this in mind, they focused their attention on standard structural components such as side members, A- and B-pillars, and bumpers. They developed an entirely new weight-optimized bumper system that also features a hot-formed steel crash beam and optimized crash boxes. This new system is 19 percent lighter than the components from previous systems, meaning that these solutions weigh as much as the average aluminum solutions, but at a significantly lower cost.

Visible surface components such as hoods and doors have also been improved as part of the InCar® plus project. Modern products such as the LITECOR® steel/polymer composite allowed the team to maintain the bending stiffness and dent resistance of the components – all at an attractive lightweight construc-

tion price. Two new highly effective corrosion-protection coatings, zinc-magnesium ZM EcoProtect® and ZM PrimeProtect, were used for the visible outer skin of the body.

The wheels and seats are lightweight and attractive. “By using high-performance steels and innovative manufacturing technologies, we have achieved incredible results in terms of weight reduction and cost-effectiveness,” explains Zörnack. Compared to today’s aluminum wheels, these are lighter, more affordable, and more environmentally friendly throughout their life cycle.” The 20-inch hybrid wheels made from steel and carbon-fiber-reinforced polymer (CFRP) also raise the bar when it comes to conception, design, and lightweight construction.

“InCar® plus offers excellent solutions for the car of the future,” beams Fischer, Director of Innovation. “Our customers will be very excited about these developments, and the project will generate additional opportunities to implement these innovations and engage in new development projects with partners.”

Visit www.incarplus.thyssenkrupp.com for more information on InCar® plus.

Photos: ThyssenKrupp Steel Europe Photography (4)

This project is a testament to our ability to combine knowledge from different specialist areas while focusing on the customer.

Heinrich Hiesinger,
Chairman of the Executive Board at ThyssenKrupp AG

Good things come in threes

TriBond®, a composite composed of three layers, makes it all possible. Different – and sometimes conflicting – characteristics are brought together in a single product.

Text: Christiane Hoch-Baumann

To make the cars of tomorrow lighter, steel materials must be able to face up to increasingly difficult challenges. One range of products that offers new opportunities in this regard, for example in the area of hot forming, is the three-layer steel composite known as TriBond®. This material is made up of three layers: a high-strength steel on the inside, and a very ductile, formable steel on the outside. During production, these layers are stacked to form a slab packet which is welded along the edges. This

Critical pillars: Stefan Myslowicki (left) and David Pieronek know the ABC of automotive engineering.



material is then rolled into a coil on a hot strip mill. "The high pressure and temperature cause the layers to permanently fuse together," says Dr. Stefan Myslowicki, who is responsible for product development with new production methods at ThyssenKrupp Steel Europe.

Users stand to benefit from the flexible sandwich design as well. "In principle, we are able to combine different types of steel with one another, and then simply vary the relative thickness of the individual layers. This opens up a wide range of new products and enables us to offer our customers tailor-made, application-specific materials, straight from the coil," explains Myslowicki, who works as a project leader for the technical development of steel composite materials in the TriBond® product range.

The special feature of TriBond® is the way in which it combines strength with high formability after hot forming, that is, in the finished component. "The process itself does not have to be adapted because the material can be processed just like a conventional hot forming steel," says Myslowicki. At present, Steel Europe is developing two different versions, TriBond® 1200 and 1400, which are already being tested by customers.

Steels in this strength range are used for crash-related structural components in the automotive industry. These are components which are required to display high deformation resistance, as in the case of

TriBond® brings new ideas to automotive engineering.

David Pieronek,
Application Technology

A- or B-pillars. David Pieronek, who is in charge of concepts in application technology, explains: "Components that are designed to absorb the energy transferred during a crash through deformation – for example, side members – must display both high strength and sufficient formability." Pieronek is responsible for evaluating the crash characteristics of steel composites. "TriBond® 1200 and 1400 present nearly perfect solutions for both applications, and offer new opportunities for implementing hot forming in the bodywork."

Naturally, this has been studied in depth and subjected to comprehensive testing. In addition, employees developed a modular simulation method to virtually analyze the capabilities of the TriBond® composite in vehicles. In crash calculations based on the ThyssenKrupp InCar®plus body structure, employees were able to identify a number of promising potential applications for this material. According to Pieronek, "Compared to the reference component made from MBW® 1500, our TriBond® B-pillar reduces the weight of the vehicle by around 1.3 kilograms. Thanks to the high strength and the good formability of TriBond® 1400, it is possible to reduce the wall thickness without a drop in performance. Buckling stability is maintained by a thicker, inner reinforcement."

The results were clear: The B-pillars in the TriBond® 1400 test series showed no cracking in the deformation zone and exhibited an impressive energy absorption capacity. "In addition, the test was characterized by reproducibility with respect to the force distance diagrams, which corresponded closely with the curve projected by a computer simulation carried out prior to testing," report Myslowicki and Pieronek.

And now customers can have a look for themselves. At the road shows, which are set to begin in October, employees will present the benefits of the new TriBond® products.

News ticker

Excellent work

Quality is rewarded. According to American engine manufacturer Cummins, ThyssenKrupp Steel Europe is one of its most reliable suppliers. The company's Power Generators division agreed, electing to present the Bochum location with an award for 'Best Quality & Performance' for its non-oriented electrical steel.



Cummins' Engines and Power Generators divisions were highly impressed by Steel Europe's perfect 100 percent delivery record and error rate of 0 ppm. Each year, Cummins, the world leader for the design, manufacturing, and sales of diesel engines, recognizes its partners around the world by presenting the 'Cummins Supplier Award'. The award ceremony was held this summer in the British town of Daventry.

Short processes save money

Diversity is the name of the game. In the automotive industry, there is an increasing demand for a wide range of different – and most importantly, cost-effective – steel components. These needs can be met using short, energy-efficient manufacturing processes. Over the past few years, ThyssenKrupp Steel Europe employees in the field of application technology have developed a number of new processes to integrate the cutting operations into the final stage of the forming process for deep drawing or eliminate these operations altogether. The patented applications can also be used for hot forming. This can help to eliminate the laser cutting step for hardenable steels or increase the service life of cutting elements. By shortening process chains and economizing press capacities, these processes significantly reduce manufacturing costs.

First prize for three phases

Making lightweight construction even lighter. TPN® steels with nano-precipitation combine high strength and reasonable elongation in a single material, endowing it with excellent product and forming characteristics. TPN®-W 780 is the first three-phase steel in this category to be manufactured by ThyssenKrupp Steel Europe. With a minimum tensile strength of 780 MPa and 14 percent elongation, the material opens up new possibilities for construction of lightweight crash- and safety-related components, for example, side members and B-pillars. These new steel products are up to 20 percent lighter than conventional products. TPN®-W 780 was developed by Dr. Brigitte Hammer and her team, and netted her first place in company's internal Steel Tomorrow competition.





Vacation for the blast furnace

Even blast furnaces need a break. **After two decades of continuous operation**, blast furnace 2 in Duisburg-Schwelgern, Germany, is being decommissioned and fully modernized.

When blast furnace 2 in Duisburg-Schwelgern is fired up again at the end of September, it will have completed an epic modernization process. The technical term for this process is ‘relining,’ and it comprises the refitting of the core unit as well as repair work on the auxiliary units. In addition, the cooling system is being modernized, the cast house is being renovated, and the hot blast stoves, the gas cleaning system, the slag granulator, and the expansion turbine are all undergoing repair work. Parallel to this work, ThyssenKrupp Steel Europe is conducting modernization work on the neighboring continuous caster 1 in Beecker-

werth, Germany. This project must be carried out while the blast furnace is offline to prevent major production downtime. As part of this modernization project, the company is completely replacing the casting machine itself and investing in a new ladle turret and a tundish, including car, among other things. “This way we can optimize the purity requirements for the steel materials,” says Ingo Knopp, who is responsible for production slab in Beeckerwerth. In addition, a new technology for cooling the hot strand is being integrated into the system. According to Knopp, “Thanks to the dual air-water cooling system, we will be able to cool the slab more gently and accurately than with our previous water cooling system. A number of different zones along the width of each segment on the hot strand are now cooled individually, and the



Some of the new components for the next blast furnace campaign were supplied by ship.



cooling process can be adjusted based on the quality of the steel and the width of the strand.” The technique helps to reduce edge defects – one of the main challenges involved in the continuous casting process – to an absolute minimum. “This improves the surface quality of the slab and ultimately results in better quality coils.” Naturally, this is very good news for customers. “These efforts will help to prepare the Duisburg location for the future. In addition, they will increase the efficiency and quality of the products in our portfolio,” emphasizes Dr. Herbert Eichelkraut, Director of Production at ThyssenKrupp Steel Europe.

This type of modernization work is not at all unusual. “Both systems have been in operation for a very long time and are in urgent need of modernization.” The continuous caster was commissioned in 1985 – the year Boris Becker won at Wimbledon for the first time. Blast furnace 2 has been going for 21 years. Back in 1993 when it was first fired up, Bill Clinton had just been inaugurated as the 42nd President of the United States. The logistics of this gigantic project, on the other hand, were definitely out of the

ordinary – the team of the Duisburg-based steel producer alone was 300 employees strong. Around 1,100 external workers from around 100 German and international companies were on the job each day, working to ensure that production could start up again as soon as possible.

The all-round modernization work, which was meticulously organized, took a little over three months. The relining of blast furnace 2 was coordinated from a 10,000-square-meter container village set up specifically for this project.

The modernization of Europe’s largest blast furnace and the neighboring continuous caster is costing the company over €200 million. This major investment is a clear response to increased competition and an acknowledgment of the state of the industry in Germany. “This is an investment in the future and a good sign of things to come for the Duisburg location and for our employees,” says Eichelkraut. “With the relining of blast furnace 2, we are ensuring that yet another core unit in our production chain is equipped with cutting-edge technology.” — jb

Photos: ThyssenKrupp Steel Europe Photography (2)

Ore, coke, and a hot furnace

Pig iron is one of the most important sources of iron used for crude steel production. Around 1.68 billion metric tons of pig iron are required worldwide each year – and this iron is primarily melted down in blast furnaces. Blast furnace 2 in Duisburg-Schwelgern produces around four million metric tons.



Hot blast stove exhaust gas chimney

HOT BLAST STOVE

Oxygen is required to gasify the coke and the pulverized coal. At least 70 percent of this oxygen comes from the air, which is compressed using blowers, and 30 percent is from pure oxygen, which is generated in air separation systems. This gas mixture is then heated to 1,260°C.

HEAT EXCHANGE SYSTEM OF THE SLAG GRANULATOR

The liquid slag from the blast furnace is first solidified with water in the slag granulator. This generates a mixture of sand and water that will later be separated. Slag sand is one of the raw materials used in the cement industry. The water is pumped into the heat exchange system so that it can be used again in the cooling process.

BLAST FURNACE

The interior of the 46-meter-tall furnace chamber is lined with fire-resistant brick. The diameter of the furnace opens to 15 meters in the tuyere area. The entire structure is surrounded by a steel framework.

COLD AIR GENERATION

This section contains four fans to supply the two blast furnaces in Schwelgern with cold air.

CAST HOUSE

In the two cast houses, the pig iron and the slag are 'tapped' and separated. The pig iron that is extracted during the tapping process is transported to the 'torpedo ladles' and then sent off to the meltshop for further processing. The liquid slag is transported to the slag granulator.

Slag granulator

Washer Mixer

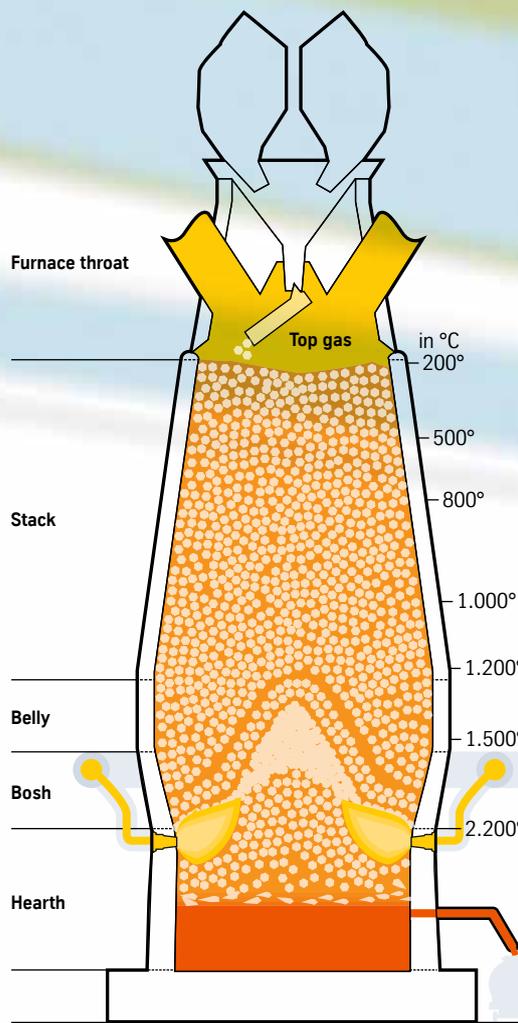
BF 2 ELECTRICAL DISTRIBUTION STATION

If things are not working here, they are not working anywhere: The distribution station supplies blast furnace 2 with power.

PULVERIZED COAL INJECTION SYSTEM

From here, the pulverized coal is pneumatically conveyed to the tuyere and then transported to the furnace using hot air. For each metric ton of pig iron, 150 to 200 kilograms of coal is injected as a substitute for the same quantity of the more expensive metallurgical coal.

Three sand silos for dehydration



HERE'S HOW A BLAST FURNACE WORKS

Furnace throat
The reduction gases leave the process as furnace gases. These gases are purified and delivered to power plants or other consumers for use in energy production.

Drying and pre-heating zones
The materials fed into the furnace (iron ore, coke, additional materials) are pre-heated and dried from bottom to top by the hot, rising reduction gases.

Indirect reduction zone (by carbon monoxide gas)
The oxygen level of the iron oxide is reduced by chemical reactions at temperatures below 1,000°C.

Direct reduction zone (by glowing coke)
At temperatures above 1,000°C, the carbon in the coke removes the rest of the oxygen from the iron oxide.

Melting zone
The hot reduction gas softens and melts the iron and the slag. Simultaneously, more carbon is released in the pig iron (carburization).

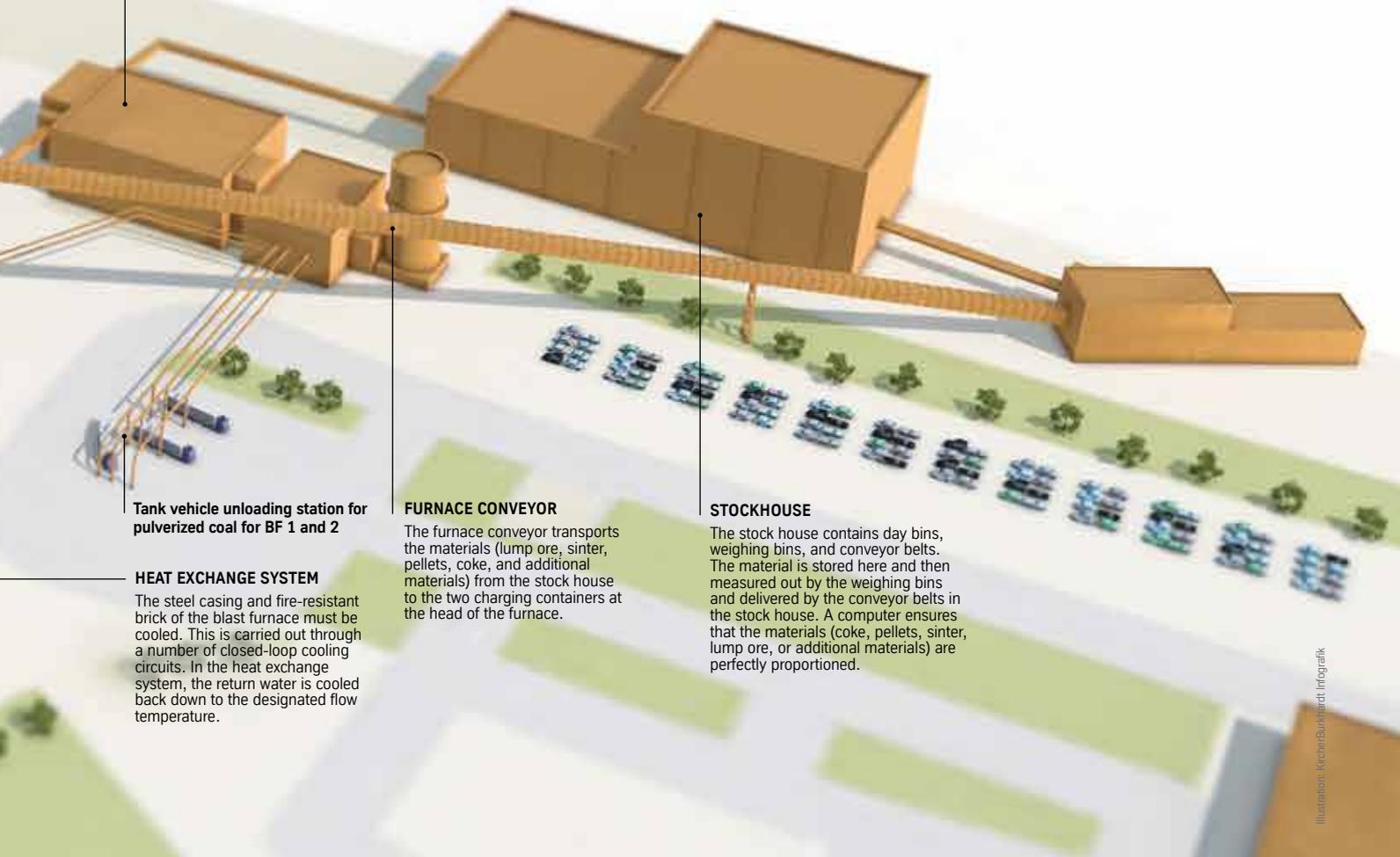
Hot blast stove

Raceway
Before it reaches the tuyeres, the oxygen from the hot air reacts with the carbon of the coke and the pulverized carbon. At temperatures of around 2,200°C, this produces the reduction gas carbon monoxide. This gas flows upwards against the coke and burden sliding in the opposite direction (countercurrent).

Pig iron and slag
The slag and molten iron, which has a carbon content of around five percent, collects in the hearth, or the bottom section of the blast furnace, and both materials are released through the taphole at temperatures of around 1,500°C.

CAST HOUSE AND STOCK HOUSE DEDUSTING

Located in the cast house in the areas near the tapholes and the pig iron and slag spouts, there are hoods designed to extract and collect dust, which is then sent to a filtering system. A fine dust is created when materials are transported and sifted in the stock house. Here, the dust is extracted and filtered.



Tank vehicle unloading station for pulverized coal for BF 1 and 2

HEAT EXCHANGE SYSTEM

The steel casing and fire-resistant brick of the blast furnace must be cooled. This is carried out through a number of closed-loop cooling circuits. In the heat exchange system, the return water is cooled back down to the designated flow temperature.

FURNACE CONVEYOR

The furnace conveyor transports the materials (lump ore, sinter, pellets, coke, and additional materials) from the stock house to the two charging containers at the head of the furnace.

STOCKHOUSE

The stock house contains day bins, weighing bins, and conveyor belts. The material is stored here and then measured out by the weighing bins and delivered by the conveyor belts in the stock house. A computer ensures that the materials (coke, pellets, sinter, lump ore, or additional materials) are perfectly proportioned.

Market + use cases

Pre-fab de luxe

The sparkling facade of the new ThyssenKrupp building stems from one of the company's own creations. It is made out of coil-coated steel panels from the ReflectionsPearl® product range.

The new Q10 building in Essen, Germany, shows steel in a whole new light. The champagne-colored elements of the facade that frame the rows of windows seem to glimmer in the sunlight. And another feature catches the eye as well: The steel panels are twice as wide as those used in the neighboring Q1 building back when it was finished in 2010. "This is a specific design choice: The appearance of the buildings on the campus varies based on their function and use," says Misha Kramer from Chaix et Morel. The Parisian architecture firm, along with Cologne-based agency JSWD Architekten, helped to plan the ThyssenKrupp headquarters in Essen. "The basic philosophy behind the design holds that the larger the individual elements, the calmer the space appears as a whole."

The new Q6, Q8, and Q10 office buildings truly make a sleek, elegant impression in the architectural ensemble. At the same time, the 3.6-meter tall, 1.35-meter wide metal elements are the product of a 'work in progress' at ThyssenKrupp Steel Europe. "These formats are more difficult to manufacture than the 67-centimeter wide panels that we used in the first construction phase," says Kramer, continuing: "They weren't ready for mass production at the time." The architect made an important contribution to the development of the new product – PLADUR® Pearl Metallic

Gold Q1 – a high-quality, coil-coated steel which is specifically tailored for premium buildings. Kramer provided the inspiration for the ReflectionsPearl® color collection, which now features 16 matte metallic tones, including three shades of green, three shades of blue, and elegantly nuanced gold, copper, silver, and bronze tones – along with the Pearl Metallic Gold Q1 tone developed exclusively for the new company headquarters.

"For the first color samples in the collection, we worked together with color expert Josselin Gildas in Paris, mixing the colors by hand," describes the architect. "It was a real laboratory experiment – and it was all a very creative, collaborative

For us, the important thing was to integrate the environment into the design.

**Misha Kramer,
Architect**

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**Puts metal in the best
light: Architect Misha
Kramer helped to develop
the steel coating.**



process.” He also paid a visit to the Kreuztal plant – where the steel strips are finished with a zinc-magnesium coating and are then coated in multiple layers of paint using the coil coating process. What he saw there made a lasting impression: “The dimensions of these systems are huge, but the amount of work that ThyssenKrupp Steel Europe invests in these types of products is absolutely incredible.” When it came to processing the sheet metal and constructing the final building elements, Kramer and his colleagues also relied on the help of specialists. “The companies we cooperated with – Pohl and Lummel – are strong innovators and collaboration partners. When it comes to mastering technical challenges, both companies are the best of the best.”

The new corporate campus is also an advertisement in its own right. “This showcase project is more impressive than any PowerPoint presentation,” says Dr. Uwe Hohlsiepe, Head of the Construction Initiative at ThyssenKrupp Steel Europe. “This project has allowed us to move from industrial buildings into the market for high quality-facades in the area of premium building materials.” But Hohlsiepe sometimes has to dispel misconceptions about the use of steel as a material. “The ZM EcoProtect® coating provides the highest level of corrosion protection, and our paint system is extremely colorfast,” reports the structural engineer. Other showcase projects include the steel group’s in-house kindergarten in Duisburg and the facade of the Kieler Yacht Club hotel. This color coating is also a forward-thinking model for energy-efficient lighting design.

According to Kramer, “The reflective, metallic surfaces can be used to reflect daylight into darker interior areas to save on electricity.” The exterior areas reflect light as well. “This was another critical factor in the decision to select this color,” says Kramer. For us, the important thing was to integrate the environment into the design of the facades.”

All in all, it is the perfect look for a company that has such a big impact on the region and at the same time reflects the region as well. — mb

Of patrons and partners

Precision steel tubes make up the core business of the Swiss Jansen Group. ThyssenKrupp Steel Europe delivers the best raw materials on the market.

Sponsorships can help to enrich projects, offer new perspectives, and provide inspiration. This is the philosophy of the Swiss Jansen Group, and what applies on a personal level also applies to the business world. For many years, the company and its various divisions have looked to product patrons to sponsor the development and production of steel tubes as well as building and plastics systems.

One such example is the division in charge of precision steel tubes, which are primarily delivered to the exacting automotive industry. In this division, Mario Gebhardt, one of the technical consultants at Jansen, offers personal consultation for customers and maintains close relationships with suppliers. "For us, the most important issues are lightweight construction and total cost reduction," he says. "To continue this trend, we must further decrease wall thickness, and to do that we will need stronger and stronger steels that are both tough and easy to process."

In the search for a custom lightweight construction solution, Jansen division manager Dr. Bernd-Michael Peters approached supplier ThyssenKrupp Steel Europe to discuss an outside-the-box idea. "We place a lot of value on high quality products and efficient research and development as this generates intelligent solutions that enable the company to stay a step ahead of the competition on the market. So we recently held a meeting at the Westfalenhütte in Dortmund to put a new spin on steel." Fifteen specialists from both companies met to share their expertise. For one entire day, they sat down to discuss steel, to analyze its composition and processing, and to define and assign tasks.

"The goal is to further improve upon the properties of the manganese-boron steels, which are used in components such as drive shafts, camshafts, or stabilizers," says Peters. "To do this, we jointly examine materials, processes, and tools. Thanks to close cooperation and process-oriented thinking, we are able to identify opportunities for improvement very early on."

This pioneering spirit is the secret recipe for success at the traditional, family-owned company. What began in 1923 as a small handicraft business founded by Josef Jansen in



Love for the product is still strong, even after 90 years of company history.

Oberriet, Switzerland, has grown into a high-tech international enterprise with 1,000 employees. Today, the group is active worldwide in three divisions: Steel Tubes, Building Systems, and Plastic Solutions. Last year, the company generated nearly CHF 300 million in sales with its product portfolio. ThyssenKrupp Steel Europe is one of the company's largest suppliers, so it was the next logical step for Jansen to engage in a direct exchange with the steel manufacturer to develop a viable, innovative concept. "Before each company ends up wasting valuable time and money conducting their own trials, we should just share ideas with one another," says Peters, summarizing the Jansen philosophy. "And with ThyssenKrupp as a partner, we are in very good hands."

Dr. Thomas Nießen, who works in technical customer support at the steel manufacturer, admits: "Naturally, these types of discussions are challenging, but challenges create a bond between us and help us make progress together." Our knowledge about materials feeds directly into new products and development projects at Jansen and opens up new markets – and nothing is more important to international competition. Peters and Nießen both agree: "Due to the heavy substitution of solid materials with tubes in the powertrain, chassis, and engine, the market for high-quality precision steel tubes is a potential growth area. Auto-

motive manufacturers have very exacting standards for these products. We have an advantage over our competition around the world, but we must continue to develop in order to maintain that advantage." This is particularly true for the Asian, South American, and North American markets. Maintaining long-term partnerships and sponsorships allows ThyssenKrupp and its technology partners to expand their respective repertoire. — hob

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Open the door

Garage door specialist Hörmann has purchased over two million metric tons of steel from ThyssenKrupp Steel Europe to date. This figure includes both hot-dip galvanized material and coated PLADUR® products.

Anyone in Germany driving a car in the 1950's probably parked it behind a 'Berry' up-and-over garage door from Hörmann. The classic garage door – which saves space by swinging forward, then upwards under the garage ceiling – laid the foundation for the current company. The business was founded in 1935 under the original name 'Bielefelder Stahltoer.' Today, the Hörmann group is an international enterprise which develops and produces doors, as well as fire- and smoke-protection systems in Europe, Asia, and North America.

Hörmann has shared a continuous working relationship with ThyssenKrupp Steel Europe for over 50 years. This business relationship is "characterized by mutual trust and respect," says Heinz Richter, Purchasing Director in Amshausen near Bielefeld, one of the group's 27 plants. Together with Martin J. Hörmann, he manages the purchasing of galvanized steel and hot-rolled strip for European plants, while the provision of color-coated steel is managed by the plant in Brockhagen. Since 2007, Hörmann has been relying on a material group management system where the plant and sales managers jointly handle all material procurement tasks. The steel manufacturer approves. "The concept is solid. We regularly meet to discuss prices and product ideas," says Sales Manager Axel Pohl.

The steel is delivered by truck to the Hörmann plants in the form of a coil. In Amshausen alone, that comes to around 70 metric tons each day. In addition, Hörmann takes advantage of the services of the ThyssenKrupp Stahl-Service-Center. Their motto, 'Out in the evening, on site in the morning,' represents a real advantage for daily procurement management. At the Amshausen plant, industrial vehicles move between the punching and profiling machines. Employees ride through on bicycles – this is a much faster way to travel



through the vast facilities. One machine welds three pieces of sheet to create a door while further on behind it, the finished models travel to the powder unit where powder of different colors is applied at a temperature of around 200 degrees Celsius. Second by second, employees and machines finish piece after piece. "It's just like Christmas – sprays and sparks everywhere!", says Richter enthusiastically. In addition to incorporating galvanized steel, the company also uses PLADUR®-coated steel in the 'Golden Oak' and 'Rose-

wood' wood pattern designs. The doors look as if they were made of wood. The finished doors are transported through the production facility on conveyor chains near the ceiling to a gigantic high rack storage facility that can store up to 20,000 units. The doors can be operated manually or using drives, and they can be equipped with additional safety equipment.

Rasmus Nilles, from technical customer service support at ThyssenKrupp Steel Europe, says: "For me, it is apparent that Hörmann's high standards for quality, its innovative corporate culture, and its strict project management philosophy are deeply ingrained in the company." Thanks to this philosophy, Hörmann will be keeping dream cars parked safely behind garage doors well into the future. — lg

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“We offer customers the perfect solution”

InCar® plus is a forward-thinking, all-round package for the automotive industry. Oliver Hoffmann from ThyssenKrupp Steel Europe and Alexander Gulden from Components Technology talk about the fruitful results of an intensive three-year development project.

Moderated by: Judy Born

Dr. Gulden, what does the Groupwide ThyssenKrupp InCar® plus research project mean for the group?

Gulden: The project bundles the automotive expertise of the entire ThyssenKrupp Group. It shows what we are capable of when we combine skills from all over the Group in our innovations – from development all the way to customer presentations.

Mr. Hoffmann, how is this project different from the previous InCar® initiative?

Hoffmann: The basic idea is the same: to offer customers a range of helpful, innovative solutions, often with a number of alternatives, or a selection of different options. The ‘plus’ simply means that time has not stood still. The past few years have seen changes in customer requirements that we have addressed in this new project.

What are some of these changes?

Hoffmann: More high-strength steels are used in car bodies today than they were a few years ago. We have also integrated new findings from a number of consumer studies and addressed the increasing move towards electromobility.

Gulden: And we are right on time with our electromobility solutions. The first cars of this kind have hit the market, and emission regulations are tightening all over the globe. We predict that the range of different drive solutions will continue to expand – these solutions include different types of drive systems, such as combustion engines, hybrid engines, and electric cars. InCar® plus offers solutions that help our customers to move forward in these areas.

With InCar® plus, ThyssenKrupp has done a lot of pioneering work and saved the automotive industry research, time, and money...

Hoffmann: We certainly think this is the case! This investment is a matter of *push and pull*. On the one hand, InCar® plus delivers products demanded by the market (*pull*), and on the other hand, it generates products we develop and present on our own initiative (*push*). E-mobility is already in high demand on the market. We don’t have to start a new trend; we’ve got to follow this trend and support it by providing the right solutions. For other innovations, such as our sandwich material, we are clearly in a *push*-type situation. It was our idea to initiate and promote the development of a three-layer sheet that is light, crash-safe, and has high flexural rigidity.

What makes you different from the competition?

Gulden: Our team is very special. Whether it’s materials, components, tools, or production technologies, we have all the skills we need under one roof. In a pragmatic sense, that means shorter lines of communication as well as the opportunity to develop new material products and types or try out hybrid materials – just because we can. This allows us to work faster and yields more mature and sophisticated products. And this helps to ensure that customers can properly integrate these solutions into their own products.

Hoffmann: Thanks to our wide-ranging experience in the automotive sector, we as a company are very different from our competitors. I have never seen a concept study so broad in scope and yet so deeply rooted in expertise as the InCar® plus project. It ranges from new chassis and steering control technologies to optimized combustion engines, and from the





InCar® plus comprises both products demanded by the market, and products that we have developed ourselves.

Oliver Hoffmann

► development of body components and seat structures all the way to electric drives.

Are these large, company-wide projects a model for the future?

Gulden: They absolutely are. This type of comprehensive program is a massive asset in approaching customers. My area, Components Technology, comprises many different – and uniquely important – divisions, for example Shocks, Steering, Camshafts, etc. In spite of that, an individual company would not be nearly as effective in catering to the needs of automotive manufacturers as we are with InCar® plus.

Hoffmann: On top of that, InCar® plus is a highly visible project within the Group. Our members of the Executive Board, and Mr. Hiesinger in particular, have been very active in their support of the initiative. This means that the executives representing our contacts and partner companies are aware of the project as well, which goes a long way towards securing its success. However, our products naturally still have to earn the approval of technical specialists.

You refer to InCar® plus as a solution kit. What do you mean by that?

Hoffmann: Let's say that the customer wants to cut 20 kilograms off of the vehicle's weight, or maybe lifecycle assessment – the analysis of the complete environmental impact of the product – is very important to the customer. Using this information, we can put together a custom set of solutions to help achieve those goals.

Gulden: It is possible to increase energy efficiency using lightweight construction, or the same effect can be achieved with engine technology – or we could employ a combination of both methods. In-



Our priority is to successfully market these developments, but we certainly have enough ideas for future projects.

Alexander Gulden

Car® plus offers alternatives, and the customer can select the best components for the job.

When will we be seeing the InCar® plus solution on the streets in real life?

Gulden: That depends on the part in question. In this project – unlike in the previous InCar® project – we have made sure to include innovations – for example electric steering systems – that can already be implemented in the new generation of vehicles. However, we also focused on a number of topics that are further down the road.

Hoffmann: Many solutions are ready in that sense, insofar as we can make them available for all customers. It also takes time for the customer to actually implement the solutions. It's important to remember that it can take a number of years for the customer to secure approval for a new material or technology.

You set aside three years for the development process. Why not longer?

Hoffmann: This time frame was very successful with our last project. Three years is sufficient to determine whether or not an idea is a good one, and it is long enough to develop the innovation to the point at which it is ready to be presented.

Will there be an InCar® plusplus?

Gulden: We certainly have enough ideas, but at present our priority is to introduce all of our current innovations on the market.

Where do you expect this project will take you?

Gulden: I can't wait to bring this portfolio to market. The excitement is spreading, and I hope that our developments will be a success.

Hoffmann: I think that I will spend some time traveling and holding discussions and presentations, and that we will work as a team to take the innovations we have developed all the way to production.

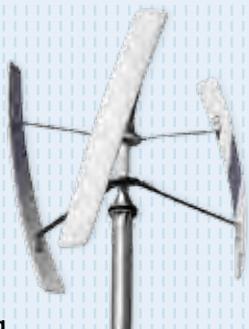
Heads

Oliver Hoffmann has been managing the Application Technology area of the Technology & Innovation division at ThyssenKrupp Steel Europe for ten years and is a member of the InCar® plus steering committee.

Alexander Gulden heads up activities in the area of Technology, Innovation & Sustainability at Components Technology. Gulden is also a member of the InCar® plus project steering committee.

2014

Dates



WindEnergy
23–26 September, Hamburg, Germany, Hall 6B, Booth 232



The WindEnergy trade fair is celebrating its premiere in Hamburg. The organizer's slogan, 'bigger, more global, more innovative', promises exhibitions from

global players from the onshore and offshore wind industry. WindEnergy reflects both the industry's dynamism and developments in key markets around the world. ThyssenKrupp Steel Europe is presenting its non-oriented electrical steel as a co-exhibitor at a booth shared with ThyssenKrupp Rothe Erde. The product portfolio here ranges from semi- to fully-finished variants that are distinguished by their excellent processability, outstanding magnetic properties, and the highest energy efficiency.

Aluminium
7–9 October, Düsseldorf, Germany, Hall 10, Booth 10/45/02 Magnesium Area



The Aluminium trade fair is the world's leading B2B platform for the aluminum industry and its most important areas of application. MgF Magnesium Flachprodukte is presenting its internationally unique process for the cost-efficient manufacturing of magnesium coils,

showcasing the broad expertise in materials at ThyssenKrupp Steel Europe.

EuroBLECH
21–25 October, Hanover, Germany, Hall 17, Booth E33

This event is the leading trade fair for the sheet metal working industry and serves as a market barometer for the sector. ThyssenKrupp Steel Europe and other Group companies will be participating and presenting innovative steel solutions geared towards production processes in different sectors. The core topics will include production optimization, energy efficiency, sustainability, innovation, and the expansion of research and development.



Stahl international annual event
6 November, Düsseldorf Congress Center, Booth P007

This year's motto, 'Perspectives for Steel,' was selected by the German Steel Federation and the Steel Institute VDEh. The event brings together steel manufacturers and customers, suppliers, as well as representatives from industry, politics, and the scientific community. This important event is expected to draw 4,000 participants from Germany and abroad. ThyssenKrupp Steel Europe will be presenting as a co-exhibitor at a booth with ThyssenKrupp Uhde Engineering Services and ThyssenKrupp MillServices & Systems.

September

Coiltech
24–25 September, Pordenone, Italy, Hall 9, Booth D7/E12

Coiltech, an exhibition for coils, electric motors, and transformers, is about to take place for the fifth time in the Italian city of Pordenone. Exhibits will include all kinds of materials, machines, and services for the production of electric motors, generators, and transformers.

October



IZB
14–16 October, Wolfsburg, Germany, Hall 7, Booth 7217

The International Suppliers Fair (IZB) has become a marketplace for automotive expertise. Major topics include electrical, electronic, and mechatronic systems; connection and joining technology; metal, lightweight, and car body construction; drive control and chassis. This year's partner region is ASEAN. ThyssenKrupp Steel Europe and the Business Area Components Technology are presenting steel solutions from the company's InCar® plus project.

November

Long Night of Industry
23 October, Rhein-Ruhr region, Germany

Throughout Viersen and Essen, Kleve and Solingen, industrial operations will open up their production facilities to the public for an evening. Company representatives will be speaking to visitors about different technologies, production facilities, and jobs. ThyssenKrupp Steel Europe will be participating in the event, holding two tours through the Beeckerwerth steel plant. Make your reservations at www.lange-nacht-der-industrie.de.



December



bauma China
25–28 November, Shanghai, China, Booth N1.410

This international trade fair is aimed at industrial and retail operations as well as service providers in the construction machinery sector. bauma offers exhibitors an opportunity to interact with target markets in China and neighboring regions. The Heavy Plate Business Unit at ThyssenKrupp Steel Europe will be presenting its hard-wearing, high-strength XAR®, N-A-XTRA®/XABO® and PERFORM® steels again this year.

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Competition

How many metric tons of steel were used to create the massive Tiger & Turtle sculpture in Duisburg, Germany?

Drop us a line if you know the right answer!

One winner of a tablet computer will be chosen at random from all correct and complete entries.

Send your answer to: ThyssenKrupp Steel Europe AG,
Heading: Prize drawing compact^{steel}, 47161 Duisburg, Germany,
or by e-mail to: compact.tkse@thyssenkrupp.com.
All entries must be submitted by: 30 October 2014 (postmark date).

Employees of ThyssenKrupp Steel Europe and their dependents are not eligible. The winner will be notified separately. The judges' decision is final.

Note: Your personal data will be used for the purposes of the prize drawing only.