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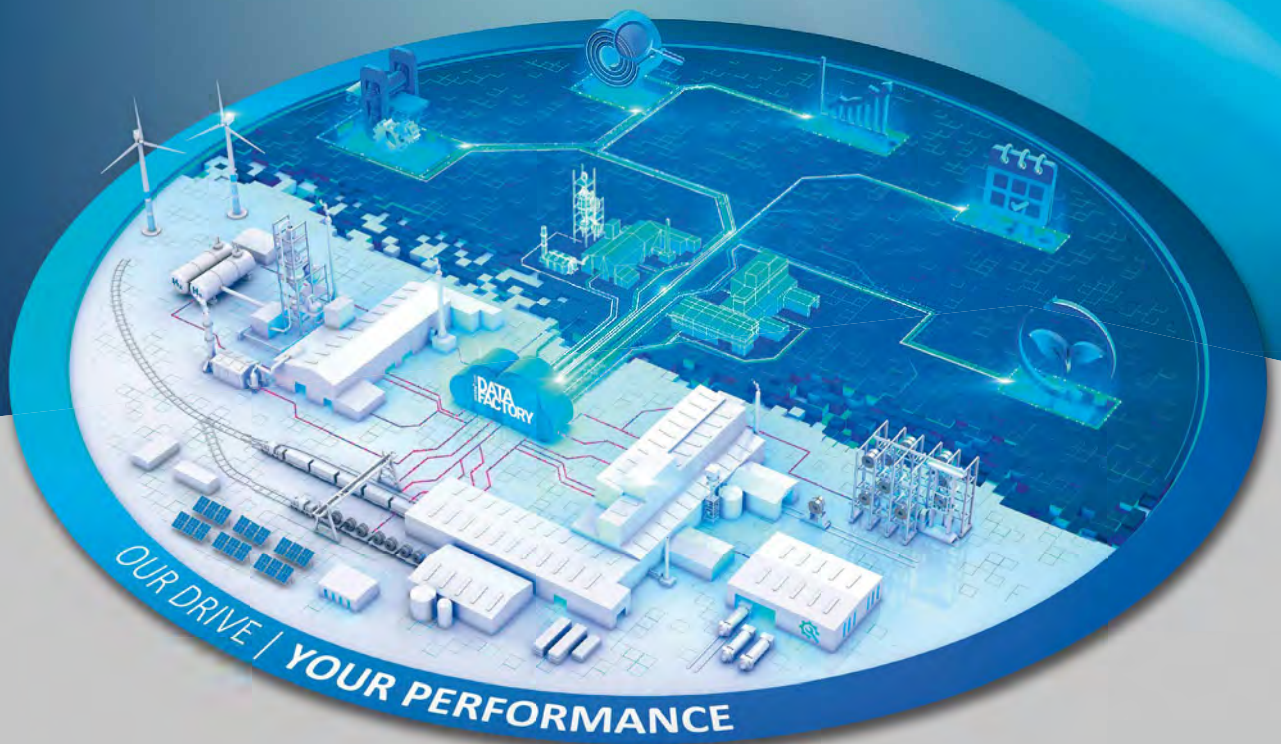
HOT ROLLING

Endless welding rolling for special steel long-product applications

STRIP PROCESSING

ConScan controls strip edge contours – coil handling to millimetric precision

Integrated Lifecycle Partnership



To be the leading partner for our customers in this transformation, SMS group bundles all competencies from electrics/automation, digitalization, and technical service. Our goal is to maintain and expand the performance of our customers' plants throughout their entire lifecycle. Together with our customers, we develop integrated solutions specifically geared to the customer's use case. In doing so, we focus on crucial KPIs such as plant availability, product quality, productivity, or delivery reliability but also on increasingly relevant topics such as sustainability and safety.



The technical challenges of decarbonisation

The decarbonisation of the steel industry is making progress. This is especially true in regions where sufficient renewable electricity is available, for example in Scandinavia. As you can read in this issue, Ovako will in future have green hydrogen available to fuel the reheating furnaces of the hot rolling mill at the Hofors works in Sweden. Elsewhere in Europe, a new greenfield project is being launched to compete with the established flat steel suppliers for green steel.

From a technical point of view, however, there are still some solutions to be found, for example in the supply of raw materials to the direct reduction plants. Companies are investigating how to process fine ore for direct reduction. We can report on two developments found by the global mining tycoon Vale and the other by the British start-up Binding Solutions. This topic will also be further pursued in the following issues of our magazine.

In addition to decarbonisation, there is much to report in the area of digitalisation and automation. One example is the development of endless welding rolling technology. This technology is now available for special steel long products, in particular for cold-heading and high-carbon grades. In addition, there are some really interesting case studies showing how production flexibility and process reliability can be improved.

Steel distribution is also actively involved in the decarbonisation of the value chain. Virtually every steel distributor and steel service centre today is emphasising how to ensure that climate-friendly steel is also CO₂-neutral on the way to the processing plants.

The decarbonisation of steel is in full swing. The industry get-together HÜTTENTAG 2023, our annual technology event in the heart of Europe, is themed "Fifty shades of green – How steel changes its colour to become climate friendly". The conference and exhibition, which will take place in Essen, Germany on 16 November, will assess the current state of this trend. We are looking forward to many interesting talks and discussions. Tickets are still available. You are welcome to register online at: www.home-of-steel.de/huettentag.

Let us meet in November in Essen, Germany,

Arnt Hannewald



Arnt Hannewald,
Dipl.-Ing., Editor



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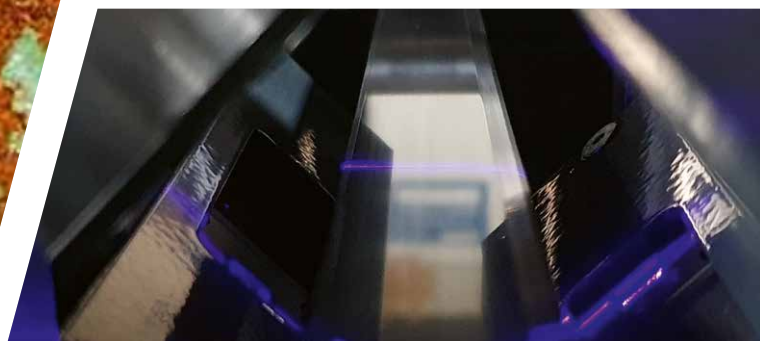
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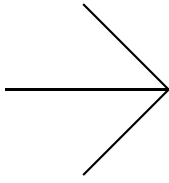


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GIANPIETRO BENEDETTI
CHAIRMAN OF THE BOARD OF DIRECTORS

Alleima appoints new President for tube division

Alleima has appointed Carl von Schantz as new President of the tube division and a member of the group's executive management team. He started his new position on 1 October. He succeeds Michael Andersson who, as previously announced, left the company in June. Carl von Schantz joins Alleima from Atlas Copco where he held the position of President for the general industry tools and assembly systems division. The position as President for the tube division is located in Sandviken, Sweden.



■ *Alleima*

Carl von Schantz heads Alleima's tube division as President (Picture: Alleima)

New Executive Vice President at Nucor

Nucor Corporation has promoted Brad Ford to Executive Vice President of its fabricated construction products division. He has been promoted from his current positions as Vice President

and General Manager of Nucor Steel Decatur. Brad Ford began his career in 2001 as a brokerage representative at The David J. Joseph Company, which Nucor acquired in 2008. He became a

Vice President of Nucor Corporation in 2022.

■ *Nucor Corporation*

New President of Tibnor

Fredrik Haglund is the new President of Tibnor, succeeding Kimmo Väkiparta, who has stepped down from the position. Fredrik Haglund has been with Tibnor since 2008, and a member of the

management team since 2016. Most recently, he was head of Tibnor Denmark. In his new position, he will be located at the Tibnor headquarters in Solna, Sweden.

■ *Tibnor*

Quor Group adds new member to management team

Saeed Patel has joined Quor Group, a provider of commodity trade risk management software, as Chief Product and Technical Officer. With 30 years of leadership, technological expertise and E/CTRM proficiency, Saeed boasts a remarkable track

record in successfully delivering strategic software development programs across various ventures, ranging from start-ups to global commodities trading firms. Before joining Quor, Saeed held the position of Group Director of product develop-

ment management at Eastnets, a global provider of compliance risk and payment solutions to banks.

■ *Quor Group*

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GERMANY

ArcelorMittal takes first steps in preparation of DRI project

Due to the approval of the early start of the project, ArcelorMittal can now start awarding studies and supplier contracts for its low-carbon steel production project DRIBE², which stands for “DRI in Bremen and Eisenhüttenstadt”.

At ArcelorMittals locations in Bremen and Eisenhüttenstadt, low-CO₂ steel is to be produced based on DRI as input material. The DRI will initially be produced in Bremen in a DRI plant using green hydrogen.

ArcelorMittal had submitted an application for funding the investment project to the Brussels authority in 2021. The Federal Republic of Germany and the Free Hanseatic City of Bremen intend to provide all the public funding for the DRIBE² project as soon as the funding commitment has been received from Brussels. The thus enabled early start of the measures makes it possible for ArcelorMittal to go ahead with the project— at its own risk. “We are now taking concrete next steps at our

plants in Bremen and Eisenhüttenstadt to prepare for the construction of the new plants as much as is possible, while we await a funding approval decision from the European Commission,” comments Reiner Blaschek, CEO ArcelorMittal Germany and Chairman of the Management Boards of both plants.

■ *ArcelorMittal*

GERMANY

EU Commission approves government funding for thyssenkrupp Steel’s decarbonization project

The EU Commission has approved German Federal and State Government funding for thyssenkrupp Steel’s “tkH2Steel” decarbonization project. This enables the German government to release the financial assistance applied for.

The pioneering concept is characterized in particular by its innovativeness and the extremely ambitious hydrogen ramp-up. On the one hand, this will quickly save a lot of CO₂ and, on the other hand, “tkH2Steel” will become a driv-

er of the European hydrogen economy. Consequently, it will function as a sheet anchor for investments in the rapid development of a cross-border hydrogen infrastructure.

The core of the “tkH2Steel” concept lies in the integration of a technologically new plant combination in Europe’s largest iron and steel plant. The 100% hydrogen-capable DR plant with two melters will have a production capacity of 2.5 million t/year of directly reduced iron. The annual saving will ultimately total up to 3.5 million t of CO₂. The startup is planned

for the end of 2026. The plant is scheduled to operate as early as 2029 with around 143,000 t/year of hydrogen.

Based on the early start of the works approved, thyssenkrupp Steel had already commissioned SMS group from Düsseldorf with the engineering, supply and construction of the direct reduction plant, as well as the two melters and associated secondary units at the Duisburg location at the beginning of the year.

■ *thyssenkrupp Steel Europe*

FINLAND

Outokumpu publishes EPD for its ferrochrome production

Outokumpu, owner of the largest known chromite reserves within the European Union, has published environmental product declaration (EPD) for its ferrochrome production.

“The environmental product declaration works as valuable evidence for Outokumpu Ferrochrome’s low carbon footprint and

increases transparency on its effect on the environment. In addition, as the EPD is third party verified and based on a vast lifecycle assessment study, it is considered unique in the market. Moreover, it will help our customers to prepare their own declarations”, says Martti Sassi, President of the Ferrochrome Business Area, which runs the chrome mine in Kemi

and ferrochrome smelters in Tornio, Finland. Through its own chrome mine, Outokumpu has unique access to an essential raw material in the production of stainless steel.

■ *Outokumpu*



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FINLAND

SSAB and Fortum explore possibilities for hydrogen-reduced sponge iron production

SSAB and Nordic energy company Fortum will launch a FEED study to explore the possibilities of making fossil-free sponge iron at an industrial scale in Raahе and building a hydrogen production plant there.

The initiative is a natural continuation to an ongoing joint research project FFS – Towards Fossil-free Steel, which began in February 2021 and is supported by Business Finland.

In January 2022, SSAB's Board of Directors made a policy decision to transform Nordic strip production and make it largely carbon dioxide-free by around 2030. During 2022, SSAB made and delivered 500 t of fossil-free steel. The now announced FEED (Front-End Engineering Design) study is scheduled to be completed in the first quarter of 2024.



The Raahе facilities may become a location for fossil-free DRI production (Photo: SSAB)

SSAB

FRANCE

ArcelorMittal Construction to modernize cold rolling mill



New control panels at the Contrisson cold rolling mill (Photo: ArcelorMittal)

ArcelorMittal Construction has awarded ABB a contract to deploy digital solutions and upgrade mill control systems at its cold rolling mill in Contrisson, as part of a modernization project.

ABB will install its manufacturing operations management system for metals (MOM4Metals) and modernize the mill's roll-gap and automatic gauge control. The manufacturing operations management system will improve information sharing, production planning and execution, reporting and asset monitoring, and support operational performance optimization. ABB is also implementing advanced roll-gap and automatic gauge control technologies to reduce thickness deviations and off-gauge length. The project at the Contrisson plant is expected to be completed in the first quarter of 2024.

ArcelorMittal

ITALY

Cogne commissions electricity-based grinding machine

At its Aosta plant, Cogne Acciai Speciali has commissioned a new grinding plant featuring a Danieli HGS200 EVO electric grinding machine.

The new grinding machine not only offers environmental benefits, but also increases

safety and productivity, whilst decreasing operating costs. The system is designed to manage the plant in a fully automated mode and increase productivity. It uses artificial intelligence and replaces three conventional machines and has met the targets of operational efficiency, accuracy,

and 25% lower electrical energy consumption.

■ *Danieli*

ITALY

Marcegaglia uses smart control system for galvanizing lines

A Fives SmartLine automatic control system for processing lines has been implemented at the Ravenna plant of Marcegaglia.

SmartLine is a digital solution based on predictive models and process knowledge

to optimize the operation of strip processing lines in automatic mode. The system processes incoming coil data, predicts setpoints for targeted properties and adjusts process parameters for each coil. Marcegaglia uses the system on four galvanizing lines. According to plant manager

Aldo Fiorini, the benefits of the system show in terms of very high process stability, 10% less gas consumption and a productivity increase of 5%.

■ *Fives*



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ITALY

Acciaierie di Sicilia upgrades billet reheating furnace

As part of a reheating furnace upgrade, Acciaierie di Sicilia, a company of Alfa Acciai, has introduced direct charging. The project was executed by Danieli Centro Combustion.

The purpose of the project was to allow charging of hot billets into the 80 t/h pusher-type furnace and reduce fuel consumption by about 40%.

The job was executed in two steps during the summer and winter plant shutdowns. The first step consisted of installing new, special water-cooled beams and a customized shield at the furnace inlet charging side, to protect the equipment against damage due to the high temperature of the hot billets.

In the second step, all the internal furnace handling guides were replaced with water-cooled ones. A fiber screen was added to preserve the external wall of the fur-



The reheating furnace upgrade at Acciaierie di Sicilia was completed five days ahead of the original schedule (Photo: Danieli)

nace and maintain the temperature of the hot billets. Moreover, a new cooling system with a high-capacity fan was installed to prevent the waste-gas temperatures in

the recuperator system from reaching dangerous levels.

| Danieli

ITALY

Acciaieria Arvedi commissions new heavy-duty shredder plant

Acciaieria Arvedi has put into operation the high-performance, shredder-based steel scrap processing plant built in Cremona by Danieli Centro Recycling.

The new plant will process about 1 million t/year of light-to-medium iron grades of scrap, including sheared light demolition scrap, to obtain a high-density quality

product that guarantees the best EAF performance in terms of yield and power consumption.

The plant consists of a 7000-Hp shredder continuously fed by a 30-m-long steel belt conveyor. A Danieli-patented noise and vibration analysis system automatically detects scrap pieces that cannot be shredded and automatically controls the reject door. A dedicated maintenance system informs about components' wear and tear. A downstream ferrous line separates steel from nonferrous metals by high-efficiency, cascade air and magnetic systems, enabling cleanliness levels close to 100% for EAF feedstock. Furthermore, an offline nonferrous separation line allows Zorba and Zurik grade recovery for resale.

An upstream 850-kW pre-shredder provides preliminary shredding and processing of heavy bales to reduce power absorption and wear inside the shredding chamber.

| Danieli



The new scrap processing plant at Acciaieria Arvedi in Cremona (Photo: Danieli)

ITALY

ORI Martin to revamp electric arc furnace plant

ORI Martin has awarded Tenova the contract to revamp the electric steel-making shop at its Brescia mill, supplied by Tenova in 1998.

Ori Martin has kept the 25-year-old EAF continuously at the state of the art through modernizations in 2015, and 2019. Under the most recent order, Tenova will replace the existing furnace with a Consteel® electric arc furnace of the latest generation and

make it ready for the installation of an innovative electro-magnetic stirrer. Start-up of the new furnace is scheduled for June 2024.

■ *Tenova*

SPAIN

ArcelorMittal launches low-carbon-footprint heavy steel plate

ArcelorMittal is now producing XCarb® low carbon-emissions steel plate of up to 18 t using slabs from ArcelorMittal Industeel, produced in an electric arc furnace using almost 100% scrap steel and 100% renewable electricity.

The slabs are transformed in ArcelorMittal's heavy plate mill in Asturias. CO₂ emissions are approximately 60% lower compared with steel plate made via the

conventional blast-furnace steelmaking route.

Heavy plate steel of this weight is typically used in major infrastructure projects, for example in the welded section and box girders for road and rail bridges. Using XCarb® recycled and renewably produced steel plate in civil engineering projects allows ArcelorMittal's customers to demonstrably reduce their scope 3 emissions (supply chain emissions) and contrib-

ute to a lower carbon footprint for infrastructure projects.

An EPD (Environmental Product Declaration), verified by a third party according to EN 15804 European Standard, will be available for XCarb® recycled and renewably produced heavy plates by the end of the year.

■ *ArcelorMittal*

LUXEMBOURG

ArcelorMittal and John Cockerill to develop industrial-scale low temperature iron electrolysis plant

ArcelorMittal and John Cockerill have announced plans to construct an industrial-scale low temperature iron electrolysis plant. The Volteron™ plant, which in a first phase will produce between 40,000 and 80,000 t/year iron plates, is targeted to start production in 2027.

ArcelorMittal and John Cockerill have been working together for the last few years on an innovative electrochemical process

transforming iron oxide into iron plates. Formerly known as SIDERWIN, with project partners including EDF, TecNALIA, Quantis, University of Aveiro, National Technical University of Athens, Norwegian University of Science and Technology, Dynergie, Recoy, CFD Numerics and Mytilineos in addition to ArcelorMittal and John Cockerill, the project has been funded through the EU Horizon 2020 programme. The next phase will be carried forward as an exclu-

sive partnership between ArcelorMittal and John Cockerill.

Volteron™ is a carbon-free, cold direct electrolysis process that extracts iron from iron ore using electricity. On a pilot scale plant, the process has proved to be highly efficient using standard iron ore. The iron plates created during the electrolysis process are then processed into steel in an electric arc furnace.

■ *ArcelorMittal / John Cockerill*

ROMANIA

Liberty Steel Galati orders new plate cooling system and water treatment plant

Liberty Galati has placed an order with Primetals Technologies for the supply of a new cooling system and a water treatment plant for its heavy plate mill line in Romania.

The multi-purpose interrupted cooling (MULPIC) technology is an in-line plate

cooling system designed to reach the cooling rates and temperature drops required for plates of varying dimensions. The technology is an in-line and integrated plate cooling system that is offered as a complete mechatronics package, combining the machinery with smart process control technology. The tailor-made water

treatment plant to be supplied will consist of several pump groups installed to supply cooling water to the cooling system. Implementation of the equipment is scheduled for the end of 2024.

■ *Primetals Technologies*

SWITZERLAND

Stahl Gerlafingen orders billet welder for endless rolling

Stahl Gerlafingen has placed an order with Danieli for the supply of a billet welder that will be directly connected to the new reheating furnace to feed the existing mill for endless rolling.

Right after the Danieli K-Weld billet welding machine to be supplied, a new Danieli Automation 2-MW Q-Heat system will be installed. This system will optimize the billet temperature after the temperature drop caused by the welding process, before the billet enters the roughing mill. A new ten-

sion-control system will speed up welding, providing the welded joint and the rolled stock enhanced mechanical properties. The new billet welder is scheduled to be started up in the first quarter of 2024.

■ *Danieli*

SWEDEN

H2 Green Steel orders electrolyzers for green hydrogen production

thyssenkrupp nucera will supply a standardized 20 MW electrolysis module "scalum" for the production of green hydrogen to power the H2 Green Steel plant to be built in Boden.

Operations at Boden are planned to start at the end of 2025, with a scheduled

ramp-up in 2026. In the initial phase, the site will produce 2.5 million t/year of green steel. The new plant will eliminate climate-damaging carbon by using green hydrogen produced in the electrolysis plant directly at the Boden plant where it has a constant supply of renewable (hydro- and wind power) electricity.

In realizing this climate-friendly project, H2 Green Steel has chosen thyssenkrupp nucera, which has a proven history in chlor-alkali and various other projects under contract with a similar or even larger production capacity in alkaline water electrolysis.

■ *H2 Green Steel / thyssenkrupp nucera*

SWEDEN

H2 Green Steel enters into agreement for supply of DRI ore pellets

In a multi-year agreement, Vale will supply H2 Green Steel with iron ore pellets as input material for its steel mill in Boden.

Iron ore in pelletized form is, along with green hydrogen from H2 Green Steel's own electrolyzer facility, critical input materials for the green direct reduced iron (DRI) production that will be used to make

near-zero emissions steel in the steel plant in Boden.

"This marks another strategic agreement for H2 Green Steel where Vale, in addition to the supply of iron ore pellets, also brings significant experience and great technical knowledge into the collaboration," says Henrik Henriksson CEO of H2 Green Steel.

Rio Tinto will also purchase and on-sell a part of the surplus low carbon hot briquetted iron (HBI) produced by H2 Green Steel during the ramp-up of its steelmaking capacity.

■ *H2 Green Steel; Vale*

SWEDEN

SSAB invests in green transformation of production in Oxelösund

SSAB's Board has taken an investment decision for the green transformation of the Oxelösund mill, enabling steel production without carbon emissions, based on recycled steel and sponge iron, from the fourth quarter of 2026 on.



SSAB's Oxelösund mill will see major investments (Photo: SSAB)

SSAB is investing in a new electric arc furnace and raw material handling equipment to turn its Oxelösund plant green. Once the transformation measures have been implemented, the Oxelösund mill will be able to use a flexible mix of fossil-free sponge iron and scrap as raw material to produce steel without carbon dioxide emissions.

“This investment decision is a very important step on our journey to fossil-free

steel production and becoming a fossil-free company. It will have a positive impact both locally and globally and help our customers to reduce their carbon footprint. At the same time, we will keep local jobs and improve the surrounding environment,” says Martin Lindqvist, President and CEO of SSAB.

■ SSAB

UNITED KINGDOM

Port of Newport is most important steel port in the UK

Associated British Ports (ABP) has announced that the Port of Newport has maintained its position as the leading steel port in both Wales and the UK for the seventh consecutive year.

The UK Department for Transport’s recently published UK Port Freight Annual Statistics for 2022 reveal that the Port of Newport is the largest UK steel port by a significant margin, having exported nearly 600,000 t more steel than all other 14 major steel-handling UK ports combined.

Last year, Newport’s steel exports reached an impressive 955,000 t, which represents 72% of the total UK exported iron and steel products from UK major ports.

Further, Newport isn’t only the UK’s number one steel port for exports, but it also stands as the leader in terms of total UK steel tonnage, handling a total of 1.4 million t of iron and steel products in 2022, 24% of the UK’s total iron and steel products.

The port’s exceptional performance is underlined by its continued partnership with Tata Steel, serving as the primary UK port for finished products exported from Tata Steel’s facilities in South Wales. The steel, manufactured at ABP’s port at Port Talbot, and finished at Llanwern near Newport Docks, finds its route to international markets through ABP’s Port of Newport.

■ Associated British Ports



Steel coils being handled at ABP’s Port of Newport (Photo: ABP)



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DECARBONISATION OF HOT ROLLING MILL

Hydrogen plant produces fossil-free fuel for reheating furnaces

Ovako inaugurated the world's first fossil-free hydrogen plant for heating steel before rolling. With the new facility in Hofors, a new chapter begins in Swedish steel history with significant potential for global emissions reduction.

Swedish Prime Minister Ulf Kristersson inaugurated the world's first plant to produce fossil-free hydrogen for heating steel before rolling on 5 September 2023. "Sweden is now the hub of the fossil-free revolution in steel making. What Ovako is accomplishing here today is a crucial step – this is green transition in action, not just words", Prime Minister stated during his opening speech.

Historically, heating steel has required substantial amounts of fossil fuels. Ovako's new hydrogen plant is the world's first facility to produce fossil-free hydrogen for heating steel prior to rolling, nearly eliminating emissions at this stage of production. The fossil-free hydrogen will be used to heat steel at adjacent rolling mills, but also for refueling fuel cell-powered trucks. The excess heat is converted into district heating.

"Today is a proud moment for me and everyone at Ovako. Here, we are showcasing the path to achieving fossil-free industrial high-temperature heat. It's fantastic to see visitors from all over the world here in Hofors. We look forward to sharing our experiences and assisting other stakeholders in reducing their emissions," said Mar-

cus Hedblom, President and CEO of the Ovako Group during the inauguration.

Also present at the event were Japan's Ambassador Masaki Noke and key individuals from Ovako's partners. "Thanks to partners such as the Volvo Group, Hitachi Energy, H2 Green Steel, and Nel Hydrogen, the hydrogen plant in Hofors will make a difference from day one," Marcus Hedblom added.

Maria Persson Gulda, Chief Technology Officer at H2 Green Steel, commented, "Technical expertise, market knowledge, and extensive hydrogen production experience are already strong competitive advantages in the growing hydrogen economy, which will be crucial in rapidly decarbonizing challenging industries. This collaboration is an excellent example of both Sweden leading the way and the importance of working together, sometimes in unexpected partnerships."

Largest electrolysis plant in Sweden

Ovako's hydrogen plant in Hofors is Sweden's largest electrolysis plant. It features

an electrolyzer that passes electricity through water to split it into hydrogen and oxygen gases, which can then be used as fuel. The 20 MW plant will generate 3,880 cubic meters of fossil-free hydrogen per hour, as well as producing oxygen. The technology solution is flexible and can contribute to stronger grid stability, enabling it to handle higher levels of renewable energy sources. Excess heat can also be utilized in district heating networks. The plan is to use local hydrogen production in all Ovako units where steel is rolled by 2030, provided there is good access to fossil-free electricity to power the electrolysis process.

The investment of around 180 million SEK is supported by the Swedish Energy Agency through "Industrial Leap". The development of the fossil-free hydrogen plant is carried out with support from the Swedish Energy Agency and the European Union.

■ Ovako



From left: Ovako Chairman Myamoto, Minister of State Ulf Kristersson and Ovako President & CEO Marcus Hedblom during the inauguration (Photo: Richard Paulsson)

TRANSITION OF THE EUROPEAN FLAT STEEL MARKET

New flat steel complex to be built in Spain

The Hydnum Steel greenfield project comprises a new minimill for flat products, including an electric steelmaking plant and an Arvedi ESP line in phase 1. A direct reduction plant and a cold rolling mill will follow in phases 2 and 3. Annual capacity is expected approximately 2.6 million tons of flat steel products after phase 4 will come on stream in 2030.

In June 2023 – during the METEC metallurgical trade fair, Hydnum Steel and Primetals Technologies signed a Memorandum of Understanding (MoU) with the intention to implement a greenfield plant for sustainable steel production in Puertollano, Spain. The comprehensive project is a collaboration between Hydnum Steel, Russula, ABEI Energy, Siemens, and Primetals Technologies as the engineering and technology provider.

The plant is set to become one of the most prominent sites for green steel production in Europe. While it will initially produce 1.5 million tons of hot rolled coils, the annual capacity is projected to be 2.6 million tons of coils (HRC and CRC) by 2030.

“We are very glad to announce the plans for this extremely important green steel project. Our minimill concept features highly efficient electric steelmaking technology and the Arvedi ESP line for unmatched energy efficiency. These solutions ensure that Hydnum Steel has the right technology to produce steel with significantly reduced carbon emissions compared with a conventional integrated steel plant,” says Andreas Viehböck, Head of Upstream Technologies at Primetals Technologies.

“The facility will be designed from the ground up to use non-fossil energy throughout the manufacturing process, thus, it will use green hydrogen into the production process with the aim of substantially reducing CO₂ emissions,” says Eric Vitse, Chief Technical Officer at Hydnum Steel.

The plant will supply high quality flat steel to different industries and applications including high strength grades for the automotive industry, as car manufacturers are moving into the electrical vehicle market. The automotive industry accounts for some 10 percent of Spain’s gross domestic product (GDP). At the same time, Spain – and Europe as a whole – are currently and traditionally net importers of flat steel.



Representatives from the project partners during the signing ceremony (from left to right): Eric Vitse, CTO at Hydnum Steel, Fernando Pessanha, CSO at Hydnum Steel, Andreas Viehböck, Head of Upstream Technologies at Primetals Technologies, Eva Maneiro, CEO at Hydnum Steel, and Norbert Petermaier, Executive Vice President, Sales at Primetals Technologies (Picture: Primetals Technologies)

The facility will be designed from the ground up to use non-fossil energy throughout the manufacturing process

Eric Vitse, Chief Technical Officer at Hydnum Steel

The partners’ intention is to implement a direct reduced iron (DRI) production unit and a complete cold rolling complex in Phase 2 and 3. The DRI plant will be powered by green hydrogen generated using local renewable energy.

Global engineering company Russula is leading the project development, with support and contribution from independent power producer ABEI Energy, global

industrial company Siemens, and Primetals Technologies.

The Hydnum steel project creates 1,200 direct jobs, as well as some 2,600 indirect jobs, in the Puertollano region, contributing massively to the development and recovery of the Spanish industry.

■ *Primetals Technologies*



The gas is transported from the neighbouring steel plant via a large pipeline (orange) to feed the LanzaTech biocatalyst that convert this gas into ethanol (Picture: ArcelorMittal)

CARBON CAPTURE AND UTILIZATION

First ethanol samples from the Steelanol plant at ArcelorMittal Ghent

The commercial flagship CCU facility in Ghent, Belgium, has commenced production. The €200 million 'Steelanol' plant is a first of its kind for the European steel industry.

The second week of June 2023 saw the first step toward full operation of a commercial scale facility that will capture carbon-rich waste gases from steelmaking and biologically convert them into advanced ethanol through LanzaTech's bio-based process. Unlike traditional fermentation, the process ferments gases instead of sugars and uses a biocatalyst instead of yeast. The facility was inaugurated in December 2022, with cold commissioning taking place thereafter. The biocatalyst has now been introduced into the facility (a process called inoculation) to begin growth and verify production of new molecules.

In May 2023, the commissioning of the installations progressed to a stage that live blast furnace gas could be introduced. The first gases from the steel mill's blast furnace were safely introduced to LanzaTech's biocatalyst. After a successful inoculation, initial samples that contained ethanol were produced, demonstrating that the carbon in the gases is being converted into new chemical products. The gas is transported from the neighbouring steel plant via a large pipeline to inject 90,000 Nm³/hour of gas to feed the LanzaTech biocatalyst that converts this carbon rich gas into ethanol. This advanced ethanol can then be used as a building block to produce a variety of prod-

ucts, including sustainable transport fuels, packaging materials, apparel, and even cosmetic fragrances, hence helping to advance the decarbonization efforts of the global chemical sector. The ethanol will be jointly marketed by ArcelorMittal and LanzaTech under the Carbalyst® brand name.

Advancing the EU's 2030 climate change targets and the circular economy

The Steelanol plant has the annual capacity to produce 80 million litres of advanced ethanol, around half of the total current demand in Belgium. It expects to reduce



From left: Manfred van Vlierberghe, CEO of ArcelorMittal Belgium, Dr. Alexander Fleischanderl, Senior Vice President and Head of Green Steel at Primetals Technologies, Jennifer Holmgren, CEO of LanzaTech, Dr. Etsuro Hirai, CTO, and Karl Purkarthofer, Head of Metallurgical Services, both from Primetals Technologies, during the inauguration ceremony on 8 December 2022 on site in Ghent, Belgium (Photo: Bevas-Styn.be)

carbon emissions from the Ghent plant by 125,000 tonnes annually, thereby advancing the EU's 2030 Climate Target Plan to reduce greenhouse gas emissions by 55% by the end of the decade. Project partners include Primetals Technologies and E4tech with support from CINEA, the European Climate, Infrastructure and Environment Executive Agency.

The first product samples from the facility mark an important step toward the circular use of carbon and the end of single-use carbon, whereby gases are no longer regarded as waste but as raw materials. In addition, the recycling of carbon means Steelanol's process of Carbalyst® ethanol production does not compete in any way with food crops, as is the case for traditional methods of ethanol production.

"This is a momentous occasion," said Jennifer Holmgren, CEO of LanzaTech. "LanzaTech, ArcelorMittal, Primetals and E4Tech have worked together and have been supported by CINEA, to create a vision of a new circular carbon economy in Europe, displacing fossil carbon from the ground. To many people, using CCU to capture emissions to make everyday products seems like science fiction, but we have shown the world what is possible on an industrial scale today."

"ArcelorMittal has a passion for sustainability and circularity and has found the right partner in LanzaTech to realize that today. The beauty of the Steelanol facility

"To many people, using CCU to capture emissions to make everyday products seems like science fiction, but we have shown the world what is possible at industrial scale today."

Jennifer Holmgren, CEO LanzaTech

is that we are enabling a new form of industrial symbiosis, connecting industries together by using gases from steel production as a feedstock for other sectors," reflected Manfred Van Vlierberghe, CEO ArcelorMittal Belgium. "This is part of the Smart Carbon Strategy we are developing. By coming together and sharing these resources between sectors, we are not only furthering our circular, Smart Carbon mission, but also helping to solve climate, CO₂ and waste challenges."

The LanzaTech process implemented at this site is fully flexible: not only can it use industrial gases from today's steel production methods but also it can adapt as industry transitions to future steel production technologies with increased green hydrogen input. This versatility enables the carbon recycling application to evolve with available

residue, waste streams, and green H₂. LanzaTech's process is already employed by three operational commercial facilities, and LanzaTech anticipates the launch of two additional commercial facilities, in Asia, before the end of the year. The Steelanol facility is expected to reach full operational capacity before the end of the year.

Funding for the commercial Steelanol facility was obtained from various sources, including the Flemish government, the Belgian federal government and the European Union's Horizon 2020 research and innovation program under grant agreement No 656437. Part of the funding was also secured with a loan from the European Investment Bank.

■ ArcelorMittal / LanzaTech

STATEMENT ON CARBON CAPTURE AND STORAGE

Fewer than 10,000 days to net zero target

In the episode No. 22 of Tata Steel's SteelCast podcast on decarbonising the steel industry, Professor Jon Gibbins, Centre Director of the UK CCS Research Community (CCS Network+) at The University of Sheffield warns that the clock is ticking for global action by governments and industries such as steel to deploy technologies that will deliver a net zero economy by 2050.

Jon Gibbins said: "What the steel industry needs to face up to is the timescale – we've got 27 years to get to net zero globally (2050) to avoid dangerous warming and that's a bit under 10,000 days." Tata Steel's host Tim Rutter, Head of Communications at Tata Steel UK, welcomed Jon to the pod to talk about the opportunity for energy intensive industries, such as steel, to utilise carbon capture and storage (CCS) as an alternative – even if as part of a transition – to technologies such as electric arc, scrap-based steelmaking.

In the podcast, Jon Gibbins argued that the principle of capturing carbon emissions from industry, and sequestering (burying) them deep in disused offshore oil and gas fields, is not only feasible but desirable, adding, "You want to keep CO₂ out of use for at least 10,000 years."

While the earliest the UK can expect to see an active carbon capture and storage facility is 2027, Jon sees existing orebased

steelmaking assets having an end-of life far beyond this date, in the UK and particularly globally. Many industry experts say there is value in re-using carbon-rich emissions for commercial uses such as aviation fuel or acetic acid, but Jon is less convinced: "Turning carbon into a fuel only to be released later will not get us to net zero," he said. "It would be nice to be able to reuse (all the carbon) but the quantities are so huge and natural processes to permanently remove the CO₂ are about 100 times too slow to avoid dangerous climate change. All the CO₂ that we put in the atmosphere now, will have to be taken out in the future by other people."

While some steelmaking sites are located close to existing oil fields and could benefit from a direct pipeline into the sea, others such as Tata Steel's Port Talbot works (Wales, UK) would have to ship the CO₂. This, said Jon Gibbins, is not such a bad thing: "Single pipelines could be down for maintenance whereas with shipping you can go to multiple destinations." "The question is not 'is Port Talbot expensive because you have to ship CO₂?' but 'Is it more expensive than anywhere else that has to ship CO₂?' and the answer is no." He added: "How many steel plants globally don't even have ship access or a CO₂ pipeline – they're in real trouble."

The podcast discussion went on to talk about one of the alternative technologies for steelmakers: scrap-based electric arc steelmaking. And while Jon appreciated the value of the technology in massively reducing carbon emissions, he made the point that leading industrial countries such as the UK have a far wider responsibility to global climate change than simply solving their own problems.

"If we hit our targets by doing things that are perfectly obvious but things that the whole world can't do, we've demonstrated nothing," he said. "We have to have a noticeable effect through demonstration. We have to do it in a way that encourages and enables other people to do the same."

Host Tim Rutter added: "It was great to have Jon on the pod for a very lively debate. With over 20 episodes under our belt, the series has hosted steel experts, academics, politicians and green groups. We're trying to open up the discussion around the challenges and opportunities of decarbonising the UK steel industry, with the people who know best."

<https://tatasteeluk.podbean.com/>

| Tata Steel UK



Jon Gibbins
(Picture: The University of Sheffield)

Turning carbon into a fuel only to be released later will not get us to net zero.

Professor Jon Gibbins, Centre Director of the UK CCS Research Community (CCS Network+) at The University of Sheffield

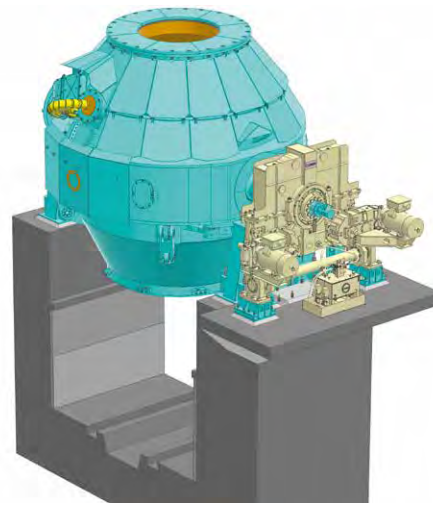
THE AMERICAS – BRAZIL

ArcelorMittal orders LD converters and gas cleaning systems

ArcelorMittal has contracted Primetals Technologies for the revamping of its steel plant in João Monlevade. Primetals will supply two new LD converters, upgrade the primary dedusting systems, and provide complete electrics and automation packages.

The new 135 t LD converters (BOFs) will feature innovative and maintenance-free suspension solutions and modern slag retention systems. The upgrade of the wet-type primary dedusting systems will capture dust from the converters and transfer it to a water treatment plant. The resulting emissions will be significantly below the legal limit set by the Brazilian government.

Additionally, the new solution will require much less maintenance than the equipment currently in use, increasing meltshop availability. Primetals Technologies will also supply a complete electrics and automation package, including basic



3D rendering of one of the BOFs to be supplied to ArcelorMittal Monlevade
(Photo: Primetals Technologies)

(Level 1) automation systems, motors and drives. The startup of the new equipment is scheduled for the first quarter of 2025.

■ Primetals Technologies

THE AMERICAS – BRAZIL

Renewable energy JV between ArcelorMittal and Casa dos Ventos

ArcelorMittal Brazil is forming a joint venture partnership with Casa dos Ventos to develop a 554 MW wind power project. ArcelorMittal Brazil will hold a 55% stake in the JV, with Casa dos Ventos holding the remaining 45%.

The project with Casa dos Ventos, a major developer of renewable energy projects in

Brazil, aims to secure and decarbonize a considerable proportion of ArcelorMittal Brazil's future electricity needs. Commenting, Aditya Mittal, CEO, ArcelorMittal, said: "The recent acquisition of Companhia Siderúrgica Pecém (CSP) immediately enhances our presence in the high-growth Brazilian market. As we expand our presence and add value to our Brazilian franchise we are con-

scious of the responsibility we have to decarbonize our operations. By collaborating with a respected energy transition operator in Casa dos Ventos, we can take advantage of the favourable Brazilian climate for renewable energy generation and make faster progress towards our climate targets."

■ ArcelorMittal

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THE AMERICAS – USA

Global Steel Climate Council publishes low-carbon steel standard

The Global Steel Climate Council (GSCC) has released The Steel Climate Standard, a global standard to measure and report steel carbon emissions.

GSCC is a non-profit organization created to lead an effort to reduce steel carbon emissions and encourage investments in low-carbon emission technology as part of the

global effort to decarbonize economies and societies. GSCC members are steel manufacturers, associations and other organizations in the steel supply chain that have a presence in 79 countries around the world.

The standard has three important objectives: Provide a single, technology-agnostic framework for steel product certification and company science-based emissions tar-

get-setting that applies to all steel producers equally on a global basis, allow all steel customers to know the carbon emissions associated with the steel products they are purchasing, and create an industry standard for achieving the emissions reduction goals in the Paris Climate Agreement by 2050.

■ *Global Steel Climate Council (GSCC)*

THE AMERICAS – USA

Gerdau to implement STATCOM at AC electric arc furnace

Primetals Technologies has won a contract to provide the Gerdau Petersburg plant in Virginia with a 69-kV static synchronous compensator (STATCOM) to support the operation of the plant's alternating current electric arc furnace.

In steelmaking, large and varying electrical loads coming from electric arc furnaces may cause disturbing effects in the electrical supply system. The disturbance is caused by fluctuations in reactive power and/or unsymmetrical loads. A STATCOM

mitigates flicker by providing or absorbing reactive current at the point of connection between the mill's electrical distribution infrastructure and the utility power system.

In 2022, Primetals Technologies worked with a team at the Gerdau Petersburg plant to develop the conceptual design for the 69-kV STATCOM and model AC EAF operation under present and future conditions. Gerdau Petersburg has accepted the conceptual design for the project and groundbreaking is imminent. The 69-kV STATCOM with an insulated-gate bipolar transistor (IGBT) module provides a dynamic and fast response, which cannot be achieved by a conventional static voltage compensator (SVC) system with thyristor-controlled reactors.

■ *Primetals Technologies*

A 34.5 kV STATCOM recently installed at Gerdau's Cartersville, Georgia, plant
(Photo: Primetals Technologies)



THE AMERICAS – USA

Cleveland-Cliffs proposes to acquire U.S. Steel

Cleveland-Cliffs Inc. has publicly announced a previously private offer that it had presented to the Board of the United States Steel Corporation on July 28, 2023. Simultaneously, Esmark withdrew its previously stated intention to bid for U.S. Steel.

The private offer, which was reiterated in writing to the U.S. Steel Board on August 11, 2023, proposed acquiring 100% of the outstanding stock of U.S. Steel for a per share value of US\$17.50 in cash and 1.023 shares of Cliffs stock.

On July 28, 2023, the offer implied a total consideration value of US\$35.00 per share of U.S. Steel stock, which represented a 42% premium to U.S. Steel's share price as of the market close on July 28, 2023. As of the close of market on Friday, August 11, 2023, this offer represents a

43% premium to U.S. Steel's share price. Notwithstanding the compelling economic terms of Cliffs' offer, it was rejected as being "unreasonable" by the Board of Directors of U.S. Steel via a letter Cliffs received on August 13, 2023.

As such, Cliffs felt compelled to make its offer publicly known for the direct benefit of all of U.S. Steel's stockholders and also make it known that Cliffs stands ready to engage on this offer immediately.

The proposed transaction has the unanimous approval of Cliffs' Board of Directors and is not subject to any financing condition. Under the terms of the United Steelworkers' (USW) collective bargaining agreement with U.S. Steel, the USW has the right to counter this proposal. On this matter, the USW has affirmed in writing to Cliffs that it endorses the transaction and will not exercise this right. Furthermore, the USW has also stated that it will

not endorse anyone other than Cliffs for a transaction.

Esmark had previously stated its intention to bid for, and negotiate a purchase with, U.S. Steel. Respecting the position of the United Steelworkers, Esmark confirmed that it will not participate in the purchase process for U.S. Steel Corporation.

■ *Cleveland Cliffs / Esmark*

THE AMERICAS – USA

Hybar ready to go ahead with rebar mill project in Osceola, Arkansas

Hybar has successfully raised US\$ 700 million in capital to build, start up and run a technologically advanced, environmentally sustainable scrap-metal-recycling rebar mill in Osceola, Arkansas.

Hybar plans to produce 630,000 t/year of rebar primarily to be used in large infra-

structure projects, including projects supported by the Infrastructure Investment and Jobs Act and the Inflation Reduction Act.

Hybar furthers northeast Arkansas' position as home to North America's most advanced and environmentally sustainable steelmaking facilities. Hybar's steelmaking

technology, to be supplied by SMS group, is designed to significantly reduce the amount of energy needed to produce rebar while also greatly limiting greenhouse gas emissions.

■ *Hybar*

THE AMERICAS – USA

JSW Steel USA to upgrade manufacturing operations

JSW Steel USA plans to invest US\$ 145 million in new projects to upgrade its manufacturing operations in Mingo Junction, Ohio.

The proposed investments by JSW Steel USA will be deployed to establish various

projects to upgrade its operations including the installation of a high-capacity vacuum tank degasser and the enhancement of supporting facilities such as the manufacturing infrastructure. The proposed vacuum tank degasser has substantially lower carbon emissions compared to a

traditional steam ejector vacuum technology. As part of this investment plan, JSW Steel USA is also implementing dynamic soft reduction technology in its casting operations.

■ *JSW Steel USA*

THE AMERICAS – USA

Nucor to reorganize plate production

Nucor Corporation will reorganize the company's plate group, including ceasing plate production at Nucor Steel Longview, LLC.

Purchased by Nucor in 2016, the mill produces heavy steel plate and has a rated annual capacity of 100,000 t. The assets

at Longview will be evaluated and deployed across Nucor's mills where appropriate.

Production will be transferred to Nucor's remaining plate mills, including its new state-of-the-art plate mill in Brandenburg, Kentucky, which began operating earlier this year. Nucor expects the phase

out of production to occur in the third quarter of this year. All Nucor Steel Longview employees will be offered employment opportunities at other Nucor divisions.

■ *Nucor Corporation*

THE AMERICAS – USA

Noxmat finds US subsidiary

Industrial heating technology specialist Noxmat GmbH, based in Germany, has founded a US subsidiary in Sterling Heights, Michigan.

With the share of the US business in Noxmat's total sales constantly rising, the company decided to drive further growth with a separate company for sales and service. The Noxmat product range includes recuperator and high-speed burners, control units for burner technology and radiant tubes for heating industrial furnaces. Noxmat products are used in thermal processing plants in the heat treatment of ferrous and non-ferrous metals. Noxmat is a member of the Aichelin group of companies.

▮ *Noxmat*



Zachary Spraggins (Business Development Manager, Noxmat, Inc.), Matthias Wolf (CEO Noxmat) and Marybel Ferszt (Office Assistant, Noxmat, Inc.) in front of the Noxmat USA headquarters at Velocity Center in Sterling Heights, Michigan (Photo: Noxmat)

THE AMERICAS – USA

Nucor Steel Utah starts endless rolling

After installation of a K-Welder and a spooler line, supplied by Danieli, spooled bars in coils weighing up to 5 t of rebar #3 to #8 are now available from the Nucor Steel facility in Plymouth, Utah.

Structured in two phases, the project started with the installation and start-up of the spooler line in 2022, followed by the installation of the billet welder, completed during the March 2023 plant outage.

A temporary, removable supporting structure was installed to allow mill operation during the building of the concrete foundations for the billet welder. The billet welder equipment was installed off-line to minimize the impact on production. The main benefits from the endless rolling and bar spooling processes include higher efficiency and material yield, finished products with excellent mechanical characteristics and good weldability, reduction in coil handling and cost sav-



Billet welder for endless bar rolling in operation (Photo: Danieli)

ings. Endless rolling also reduces the risk of cobbling. ▮ *Danieli*

THE AMERICAS – USA

Outokumpu explores options to strengthen its position in the U.S.

Outokumpu is conducting a feasibility study to explore options to expand its U.S. operations to meet the increasing demand for locally produced sustainable stainless steel.

Specifically, Outokumpu is seeking to increase its existing cold rolling capacity and investigating different options for its hot rolling arrangements in Calvert, Alabama. With respect to the latter, one option under consideration for the company is to build its own hot rolling mill. Outokumpu is in a good state of readiness to make a final investment decision and will communicate separately if such a decision is made.

These considerations are made in preparation of the third phase of its corporate strategy. This phase will focus on further strengthening the company's market posi-



Strip processing line at the Calvert cold rolling mill (Photo: Valokuvaja / Outokumpu)

tion and develop more globally diversified operations including Americas expansion. | *Outokumpu*

THE AMERICAS – USA

Nucor-Yamato orders reheating furnace for section mill

Nucor-Yamato Steel has placed an order with Danieli Centro Combustion for the supply of a walking-beam furnace, along with upstream and downstream automation and material handling equipment, for its beam mill in Blytheville, Arkansas.

The project will be integrated into existing plant operations with the latest Danieli Automation level 1 and level 2 control sys-

tems. These include an optimization system that automatically adjusts the set points based on the thermal status of the stock, material tracking and actual mill pacing. The furnace will feature Danieli-patented Hydro-Mab burners that can be fired with 100% H₂. The new furnace is expected to be operational by spring 2025

The supplied solution includes an optimized material handling layout to be exe-

cuted in phases. This will allow Nucor-Yamato to maintain production using the existing furnace without any major interruptions. Thus, changes to the existing layout will be minimized, enabling the use and retention of most of the existing equipment until the new equipment is installed.

| *Danieli*

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THE AMERICAS – USA

Nucor to start carbon capture & storage project

Nucor Corporation has signed an agreement with ExxonMobil to capture, transport and store carbon from Nucor's direct reduced iron (DRI) plant in Convent, Louisiana.

ExxonMobil will capture up to 800,000 t per year of CO₂ from the DRI plant and

store the CO₂ at an ExxonMobil-owned facility in Louisiana. "This transformative CCS project with ExxonMobil is a key part of our decarbonization strategy and will result in some of the lowest embodied carbon DRI or HBI in North America," said Leon Topalian, Chair, President and Chief Executive Officer of Nucor Corporation.

The project is expected to start-up in 2026 and supports Louisiana's objective of reaching net-zero CO₂ emissions by 2050.

▮ *Nucor Corporation*

ASIA – CHINA

Xingtai orders reducing & sizing block

Xingtai Iron & Steel and Friedrich Kocks have signed a contract for the installation of an RSB® 370++/4 reducing & sizing block in 5.0 design.

This block will be the centerpiece of Xingtai Iron & Steel's new rolling mill complex for the production of special steels. The new 3-roll RSB® 370++/4 will be located as the finishing block after 18 stands in H/V arrangement in a 900,000 t/year SBQ mill. It will produce bar in coil (BIC) within a finished size range from 16 to 52 mm. Kocks' scope of supply also includes the remote control for stand and guide adjustments, roll shop equipment, and software solutions for optimum rolling results. The commissioning of the RSB® is scheduled for the end of 2024.

▮ *Kocks*



Contract signing for the supply of a reducing & sizing block to Xingtai Iron & Steel
(Photo: Kocks)

ASIA – CHINA

HBIS produces DRI with higher than 60% hydrogen share

With its new Energiron® direct reduction plant, HBZX High Tech, part of Hebei Iron & Steel Group (HBIS), is producing DRI using more than 60% hydrogen in the feed gas mix.

At its Xuan Hua plant in Zhangjiakou, Hebei province, HBZX operates a 600,000 t/year

Energiron® plant, a DRI production technology jointly developed by Tenova and Danieli. This hydrogen-enriched gas-powered industrial-scale facility operates with a CO₂ release as low as 250 kg/t of DRI. Furthermore, the carbon dioxide is selectively recovered by a CO₂ removal unit. Part of it will be reutilized in downstream

processes using CCU and CCS solutions and leading to final net emissions of just about 125 kg of CO₂ per tonne of DRI.

▮ *Danieli*

ASIA – INDIA

ArcelorMittal Nippon Steel orders plant equipment for the greenfield project

AM/NS India has signed a contract with Danieli Corus for the supply of three sub-lance-based BOF process control systems.

The sub-lance-based process control systems supplied by Danieli Corus are for the three 350-t converters of the greenfield BOF shop at AM/NS India's Hazira plant. The systems will reduce the tap-to-tap

time of the converters, while allowing for higher scrap rates and lower hot metal and flux consumption.

■ *Danieli Corus*

ASIA – INDIA

SAIL signs MoU on decarbonization of steel production

SAIL (Steel Authority of India Limited) and SMS group have drawn up a memorandum of understanding to

work together on sustainable steel production and decarbonization efforts.

This partnership aims at addressing the challenges of reducing carbon emissions and making the steel industry more environmentally friendly, with particular emphasis on decarbonizing steel production in SAIL's integrated steel plants across India. SMS will provide its technological expertise for design and engineering activities, equipment supplies, and technical assistance for erection and commissioning projects at SAIL's facilities across India.

"We are very proud to team up with a public sector enterprise responsible for steel production in India, and we look forward to collaborating in future," said Mr. Marco Asquini, CEO, APAC & MEA Region of SMS group.

Shri Saumya Tokdar, CGM of SAIL's Bhilai Steel Plant, said: "SAIL is actively looking for solutions to facilitate the transition to green steel production, and thus contribute to a sustainable future."

■ *SMS group*



Marco Asquini and Shri Saumya Tokdar after signing the MoU (Photo: SMS group)

ASIA – INDIA

ArcelorMittal Nippon Steel to modernize slab casting plant

AM/NS India has ordered slab-caster process control systems from Danieli Automation and a new slab inspection and conditioning plant from Danieli Centro Maskin as part its casting plant upgrade.

AM/NS India has selected Danieli Automation advanced process technologies to upgrade three slab casters in operation in the Hazira steelmaking plant No. 1. The scope of supply includes Level 2 systems

consisting of process control models and production tracking capabilities. Dedicated models will manage the cooling process and quality assessment of cast slabs, with specific cut-optimization modules. The new, slab inspection and conditioning plant in Hazira is scheduled to be in full operation by the third quarter of 2025.

Danieli Centro Maskin has been awarded a contract by AM/NS India for the supply of a new slab-inspection and -condi-

tioning plant based on the Danieli SuperGrinder technology. The two grinders supplied will process slabs of a wide array of automotive, low- and medium-carbon, HSLA, API, silicon, dual-phase and alloy steel grades. Primary conditioning will be followed by spot grinding in connection with the Danieli IntelliGrind® surface-defect inspection system.

■ *Danieli*

ASIA – INDIA

Tata Steel to install additional hot-blast stoves in three blast furnaces

Tata Steel has awarded Danieli Corus a contract for the addition of a fourth stove to the existing hot-blast systems in the Jamshedpur H and I furnaces, as well as No. 2 blast furnace in Meramandali.

The objective of the installation is to achieve greater operational and maintenance flexibility, while allowing for

increased blast furnace production rates. The three blast furnaces were commissioned in 2008, 2012 and 2014, respectively. Provisions for expanding the hot-blast systems were made as early as in the original construction phase. Therefore, the new stoves can now be built in the available space directly adjacent to the third stoves.

The new stoves will be equipped with the proven Danieli Corus “mushroom” dome, with the dome refractories being supported independently by the steel shell. New burners will guarantee improved mixing efficiency and stability.

| Danieli Corus

ASIA – INDIA

Rungta Mines to install two high-speed bar and wire rod mills

Rungta Mines has placed orders with Danieli to supply two high-speed bar and wire rod mills to be installed at the Dhenkanal and Kamanda Steel plants in the state of Odisha.

The mills will produce a total of 1 million t/year of rebar in bundles from 8 to 40 mm in diameter, and wire rod in coils from 5.5 to 20 mm in diameter in low and medium carbon steels.

The mills will feature inline bar quenching systems for heat treatment, bar coun-

ters and the Danieli-patented oil-film-bearing laying heads. Sund Birsta coil finishing facilities will ensure perfect coil forming for smooth downstream unwinding.

| Danieli

ASIA – JAPAN

Chiyoda Steel orders induction heating technology

Chiyoda Steel has awarded Danieli Automation the order for the supply of a Q-Heat induction heater to be installed at the company's Ayase electric steel-making plant in Tokyo.

The new 4-MW Q-Heat induction heater will reheat cold billets up to rolling temperature in less than 8 minutes. It will operate

in coordination with the 6-MW Q-Heat system installed in front of the rolling mill to perform the hot charging process. The system is designed to increase its current capacity of up to 20 t/h to up to 9 MW and 30 t/h.

The new system will completely replace the existing gas reheating furnace, improving plant efficiency and flexibility, whilst

eliminating direct CO₂ generation from the billet gas-reheating process. The installation is planned to take place by April 2024.

| Danieli

ASIA – SOUTH KOREA

POSCO to build electric arc furnace plant and start electric steelmaking

Tenova has received an order from POSCO for the supply of an electric arc furnace to be built at the Gwangyang plant.

A key part of POSCO's transformation towards sustainability consists in the grad-

Gwangyang works of POSCO where the new electric arc furnace will be built (Photo: POSCO)



ual conversion from the BF-BOF route towards electric steelmaking. The order now placed with Tenova includes a full-platform EAF with a tapping capacity of 280 t of liquid steel, equipped with the Consteel® continuous scrap charging system and the electromagnetic stirring system Consterrer®, joint-

ly patented by Tenova and ABB. The EAF will be installed in a dedicated new section of the Gwangyang plant and is scheduled to start production by the end of 2025.

■ *Tenova*



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ASIA – SAUDI ARABIA

Essar signs LOI on supply of iron ore pellets for green steel project

Producer and supplier of high-grade iron-ore pellets, Foulath Subsidiary of Bahrain Steel, has signed a Letter of Intent to partner with Essar Group in the supply of iron ore pellets to the Green Steel Arabia (GSA) project.

Through this partnership, Bahrain Steel will deliver 4 million t/year of DR-grade pellets to Essar Group. The LOI will secure 50% of raw material supply for

the new steel plant. Commercial production is expected to begin from the year 2027. The Essar project will have a DRI capacity of 5.0 million t/year, hot strip capacity of 4.0 million t/year, cold rolling capacity of 1.0 million t/year as well as downstream galvanizing and tin plate lines.

■ *Essar / Bahrain Steel*

ASIA – THAILAND

Meranti signs cooperation agreement for new green steel plant

Meranti Green Steel, Singapore, has entered into a cooperation with Danieli to set up a new green steel project in Thailand.

Meranti's new DRI-based green steel plant will produce hot-rolled coils, making use of renewable energy solutions, including solar and wind energy, and hydrogen. It will feature an Energiron direct reduction

plant with technology jointly developed by Tenova and Danieli, ready for a transition to 90% hydrogen; a Danieli Digimelter melting unit featuring a Q-One power feeder capable of processing green energy; and a Danieli QSP-DUE thin-slab casting and rolling line for full flexibility in terms of strip width, thickness, and steel grades.

■ *Danieli*



Meranti and Danieli representatives during the signing ceremony (Photo: Danieli)



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ASIA – VIETNAM

Hoa Phat orders roll grinders

Hoa Phat has placed an order for the supply of Pomini roll grinders to be installed at Phat's new hot rolling mill in Dung Quat, Quang Ngai province.

The order includes a full set of roll grinders for work and back-up rolls with and without mounted-on chocks. All machines will be equipped with Pomini's latest HMI and roll inspection systems with eddy current and ultrasound probes. The roll grinders come with a Pomini process monitoring system and continuous profile compensation to easily achieve the best roll surface quality with the highest profile accuracy. The digital package will provide constant remote condition monitoring for each machine and all sorts of operational and maintenance support.

■ *Tenova*



Roll shop with high-precision roll grinders (Photo: Tenova)

ASIA – EMIRATES

GrafTech to open new sales office in Dubai

GrafTech International, manufacturer of high-quality graphite electrode products, is opening a new sales office in Dubai.

"The opening of our new sales office in Dubai reflects our commercial strategy to operate with a global footprint," comments Inigo Perez, Senior Vice President, Commercial and CTS. "With experienced sales and customer service teams around the

world, we are committed to offering comprehensive support to GrafTech's customers located across the globe."

■ *GrafTech*

AUSTRALIA

Orrcon Steel orders tube mill

Orrcon Steel, part of BlueScope, has ordered an OTO tube mill from Fives. The new mill will be installed in Unanderra, New South Wales, to serve the needs of the regional industry.

The new mill will produce high quality tubes and sections for residential, industrial and commercial buildings, as well as

structural and architectural elements including those with aesthetic and special geometrical features.

Together with its regional partner Pro-Tube Engineering, Fives will provide Orrcon Steel with a complete OTO tube mill line, from coil loading to an automatic packaging system for 10-inch (25 cm) diameter steel tubes. The project targets

to obtain a green production certification for manufactured tubes for the regenerative systems and energy-efficient motors to be installed at the facility. The new line is scheduled for commissioning in early 2024.

■ *Fives*

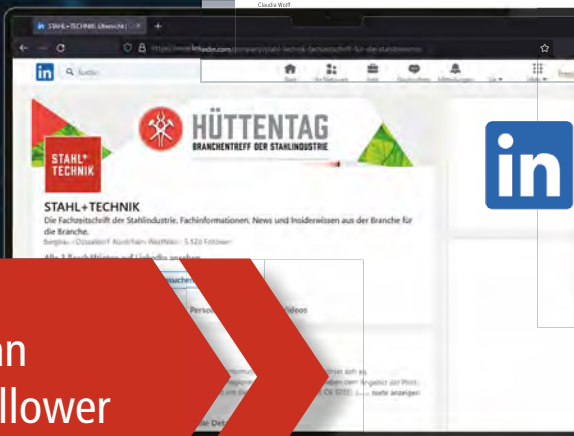
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 DVS MEDIA

RAW MATERIALS

New iron ore briquette for direct reduction

Vale has successfully tested a new type of iron ore briquette, adapted for the direct reduction route. The new type of briquette emits about 80% less CO₂ compared to pellets in its manufacture. It can also be used as a burden for the blast furnace (BF-BOF route).

Direct reduction is one of the routes used in steel production. It is considered to be more environmentally friendly than the blast furnace route, because it emits less carbon and other Greenhouse Gases (GHG). Studies show that for every ton of steel produced in the blast furnace, two tons of CO₂ are emitted, while in direct reduction, carbon emissions fall to 0.6 to 1 ton. Iron ore supply shall meet the trend of the steel industry to increasingly adopt the direct reduction route.

In recent months Vale has stepped up development of a new type of iron ore briquette for this route. So far, seven experimental tests have been carried out at plants for different clients in the Americas. The tests carried out so far are known as basket tests. Small quantities of briquette and pellets were placed side by side in baskets, which fed the reactors.

“With the development of this new type of briquette, Vale is taking another important

step in its contribution to reducing emissions from the steelmaking chain through innovation, always in close collaboration with its clients and development partners,” explains Rogério Nogueira, Vale’s director of Product and Business Development.

In one of the tests carried out, for example, the new product outperformed pellets in metallization, reaching a metallic iron content of around 98%, while pellets reached 95%. This result indicates that the new type of briquette can improve the productivity of steel mill clients.

The briquette also performed well in terms of disintegration. In one of the tests, for example, around 7% of fines were generated, against 14% with the use of pellets. The smaller presence of fine particles as a result of the disintegration facilitates the passage of the gas through the reactor, increasing productivity and reducing the consumption of this fuel, which contributes to reduce carbon emissions.

The next step in the development of the direct reduction briquette is to carry out industrial tests, which should begin in June, in a reactor of a client in North America.

Two decades of development

Announced by Vale in 2021, after about 20 years of development, the briquette is produced from the agglomeration at low temperatures of iron ore using a technological solution of binders, which gives the final product high mechanical strength. Therefore, it emits less pollutants and GHG when compared to traditional agglomeration processes (pelletization and sintering).

The briquette can substitute any direct load (sinter, granulates and pellets) in the steel mill furnaces. The substitution of the sintering stage in the blast furnace route is what allows the potential reduction of GHG emissions by up to 10%. This route is the most used worldwide, while direct



Iron ore briquettes could become an alternative to pellets as feedstock for direct reduction plants
(Picture: Por of Acu)

Vale's unique and state-of-the-art briquetting technology can be a game changer in low carbon solutions offered by the mining sector

Jose Noldin, CEO of GravitHy

reduction is more common in regions with abundant natural gas at competitive prices, such as the Middle East, North America and Argentina.

To be produced, direct reduction agglomerates (briquettes and pellets) require iron ore with a higher content, approximately 67%, besides low rates of contaminants such as silica and alumina. Agglomerates for blast furnaces can be produced with ore grades lower than 65%.

Vale is working to increase its production of high-quality iron ore and expand its capacity to concentrate ore, which also raises the iron ore grade, enabling the company to meet demand from steelmakers for these products.

Product in expansion

Vale is building two briquette plants (each 6 million t per year) at its Tubarão Unit in Vitória, Espírito Santo, Brazil. Start-up of the first plant is planned for the end of the first half of the year, while the second should begin operations at the end of the year.

In addition, memorandums of understanding have already been signed with more than 30 customers to study the implementation of decarbonisation solutions, including the construction of briquette plants located on the premises of some customers.

Among the agreements signed, three of them aim to install Mega Hubs in Middle Eastern countries (Saudi Arabia, United Arab Emirates and Oman) to produce hot-briquetted iron (HBI) to supply both local and seaborne markets, with a significant reduction in CO₂ emissions. At the hubs, Vale is expected to build and operate iron ore concentration and briquetting plants, supplying the feed for the HBI plants, which will be built and operated by investors and/or customers. Vale is also studying the creation of similar hubs in Brazil.

Iron ore briquette contributes to achieving Vale's commitment to reduce 15% of scope 3 net emissions by 2035. The company also seeks to reduce its absolute scope 1 and 2 emissions by 33% by 2030 and achieve neutrality by 2050, in line with the Paris Agreement ambition to limit global warming below 2°C by the end of the century.

Briquette production for green ironmaking plant in France

Vale and the French green DRI producer GravitHy have signed a Memorandum of Understanding (MoU) to pursue solutions focused on a carbon-neutral ironmaking process by using Vale's innovative iron ore briquettes technology. Within the scope of the MoU, Vale and GravitHy will jointly evaluate the construction of a plant co-located in GravitHy's site in Fos-sur-Mer (France) to produce direct reduction briquettes from Vale's high-quality iron ore feedstock.

GravitHy's first Direct Reduction Iron (DRI) plant is expected to start-up production in Fos-sur-Mer in 2027. The plant is designed to produce DRI using hydrogen as reductant fuel, reducing substantially carbon emissions in the steelmaking chain when compared to hot metal production through the integrated BF-BOF route. The DRI plant to be built by GravitHy is expected to have a production capacity of 2 million t per year and investments of € 2 billion. The company is advancing its engineering and permitting studies, and construction is expected to start in 2024.

Rogério Nogueira, director of Product and Business Development at Vale, said: "Vale is committed in providing low carbon emission solutions for the global steel industry. GravitHy is a good example of a changing steel market where new players take on the challenge to utilize hydrogen to produce low carbon DRI to supply an expected growing EAF production capac-

ity. We are happy to work with a frontrunner in H₂-based DRI production as we believe in the outstanding features of our iron ore briquettes for DRI production".

Commenting about the MoU, Jose Noldin, CEO of GravitHy said: "Decarbonization of steel production is a major challenge and requires innovative solutions, not only in technology but also in product and new business models. We are very pleased to start this collaboration with Vale to assess their unique and state-of-the-art briquetting technology that can be a game changer in low carbon solutions offered by the mining sector".

This MoU reinforces Vale's confidence on direct reduction route and hydrogen usage to enable steelmaking decarbonization. Vale is committed to reduce 15% of net Scope 3 emissions by 2035. Since 2021, Vale engaged with more than 30 ironmaking clients representing approximately 50% of the company's Scope 3 emissions. Additionally, Vale seeks to reduce its absolute Scope 1 and 2 emissions by 33% by 2030 and achieve net zero by 2050, in line with the Paris Agreement, leading the way to sustainable mining.

In May 3rd, Vale informed that it has successfully tested a new type of iron ore briquette, adapted for the direct reduction route, which will contribute to the decarbonization of steel production. The new type of briquette emits about 80% less CO₂ compared to pellets in its manufacture, abating the company's direct and indirect emissions (scopes 1 and 2).

GravitHy was launched in 2022 by a world-class consortium comprised by EIT InnoEnergy, the innovation engine for sustainable energy supported by the European Institute of Innovation & Technology, a body of the European Union (EU), Engie, Plug, Forvia, Groupe IDEC and Primetals Technologies. GravitHy is a sustainable iron company, with its first plant to be located in Fos-sur-Mer, Southern France. As the steel industry decarbonizes, GravitHy will address the growing demand for green iron, by producing and using low-carbon hydrogen to produce DRI. The DRI will be used directly or traded globally under the form of Hot-Briquetted Iron (HBI) to be used as a feedstock in low CO₂ steel production.

■ Vale

RAW MATERIALS

Cold-bonded iron ore pellets

An innovative technology developed by Binding Solutions Ltd. reduces energy usage and CO₂ emissions by up to 95% and 93% respectively compared to traditional iron ore pellet processes. BSL has installed a 2 tonnes per hour pilot plant. Now the company is developing a demonstration plant project with higher capacity.



Using cold-bonded pellets has the potential to significantly reduce CO₂ emissions in ironmaking (Picture: Binding Solutions Limited)

Cold pelletisation of iron ore

The patented cold-bonding process developed by Binding Solutions significantly reduces carbon emissions from metals production, whilst helping the producers of steel and other metals to re-use waste materials, reduce costs and cut emissions of NO_x and SO_x. BSL's technology also has a very large addressable market as it can be applied to waste dumps, mined ores and pellets for the EAF market.

Cold pelletisation of iron ore has the potential to replace the need for sintering and induration processes which are very energy intensive and account for approximately 15% of CO₂ emissions from the global steel industry. Annual emissions from the steel industry are estimated as equivalent to 2.6 billion t per annum (worldsteel), so BSL's technology

could prevent the emission of up to 390 million t of CO₂ per annum. This is equivalent to the total annual emissions of South Africa or approximately 1% of global emissions every year. The technology has been commercially approved at a major steel plant in the UK where it has operated since 2013. The technology enables reductions of:

- › 95% in energy usage
- › 93% in carbon dioxide (CO₂) emissions
- › 100% in sulphur oxides (SO_x)
- › 99% in nitrogen oxide (NO_x)

■ *Binding Solutions Limited*

Earlier this year Binding Solutions Ltd. (BSL), the UK-based metals processing technology company, announced a US\$17.5 million strategic investment from Mineral Resources Limited (MinRes), a leading Australian mining services company with a growing world-class portfolio of mining operations in iron ore and lithium. BSL will use the funds raised to progress the design and construction of a demonstration plant for its innovative technology capable of producing approximately 50 tonnes per hour of cold-bonded iron ore pellets. BSL is considering a number of potential locations for this demonstration plant in the UK, EU and Western Australia and expects to make a decision on site selection by the end of 2023.

BSL's patented process uses minimal heat and very limited energy to produce high quality pellet or briquette products primarily for the global iron ore and steel industry. The technology reduces energy usage and CO₂ emissions by up to 95% and 93% respectively compared to traditional induration processes, while also virtually eliminating SO_x and NO_x. At the same time, BSL's technology enables reductions in capital investment costs of approximately 90% per 1 million t/year of production. BSL has recently installed a 2 tonnes per hour pilot plant in its lab at the Materials Processing Institute in Teesside (England) with the intention of running batches for customers.

BSL and MinRes have also agreed to partner on several initiatives that leverage their respective strengths in technology development and industrial scale materials handling as well as mining services. MinRes has the right to licence the BSL technology to manufacture cold-bonded pellets from iron ore at its own mines and will become the preferred builder of BSL pellet plants in global markets. MinRes will also provide design and engineering, project management, as well as procurement support for the Development Plant. MinRes also has the right to appoint a member of the BSL board of directors.

MinRes Managing Director Chris Ellison said: "BSL's technology has the potential to rapidly play a major role in the decarbonisation of the global steel industry. MinRes has a track record of using innovation to solve problems and unlock value, and we are excited to partner with BSL to support this innovative technology."

We are accelerating our plans for a demonstration plant so that we can help reduce emissions from one of the largest carbon emitting sectors.

Julian Lee, CEO of Binding Solutions

Julian Lee, CEO of Binding Solutions said: "The partnership with MinRes is a hugely significant step for BSL and further validation of the innovative technology we have developed in the UK. Working with such a respected player in the global mining industry has the potential to rapidly accelerate and de-risk the roll out of our technology by giving us access to the

deep expertise and networks that MinRes has built with some of the industry's largest players over many years. We are now focussed on rapidly progressing plans for our demonstration plant and exploring the potential to apply our technology to lithium, a critical battery material."

| Binding Solutions Limited

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STEELMAKING

Seven Gerdau EAF plants upgraded with new electrode-control systems

The patented technology from Danieli provides control for the electrodes based on a high-performance HiPAC process controller, with fast data acquisition and real-time process parameters elaboration

Ordered all at once, seven electric arc furnaces of Gerdau in Brazil have been recently upgraded with the innovative Danieli Q-Reg advanced electrode-control system. It delivers ideal arc coverage for each electrode, improves arc stability, and analyzes the radiation index. These process feedbacks enables the dynamic adjustment of the setpoints, to maximize furnace efficiency and protect against panels damages, thus ensuring a reliable and safe operation.

Furthermore, Q-Reg advanced diagnostic tools enable deeper insight on every heat, including visualization of circular diagrams and variable trends, Gauss, 3D visualization and Fast Fourier Transform (FFT) of electrical parameters.

Appreciative commentaries from process specialists

After commissioning the engineers at the various meltshops sent very positive feed-

back including the following operational details.

Francisco Willian da Silva Gomes. "The installation of the regulator on the EAF at Cearense provided significant impacts on the process and operational stability. After installing the equipment, a reduction of electric power consumption in the EAF, a PowerOn reduction (about 7%) and a considerable decrease in the occurrence of breakdowns (about 50%, with a strong impact on operational exposure to process) were noticed." He added: "These reductions were confirmed by the decrease in the consumption of electrodes (approx. 13%). During the period, there were variations in the use of scrap and pig iron (0 to 18% of cold load) and operational improvements (optimization of chemical recipe, cold load stabilization, etc.); in these challenging scenarios, the regulator allowed us to capture the excellent performance of our furnace and ensure operational safety."

Guilherme Pimentel Silva. "At Gerdau São Paulo, the Q-REG took process performance and control to the next level. We had a significant improvement in electric power indicators of almost 8%, electrode consumption with gains of almost 10%, and elimination of electrode breakdown for more than four months, as well as a refined power control in the furnace that greatly contributed to a significant PowerOn reduction." He continued: "From a safety point of view, there is a monitor for panel temperature, associated with the regulator and able to work in case of emergency without the operator's intervention. In addition to this, we are fully supported by Danieli for modifications and assistance in case of failure."

Luiz Maurício B de Azevedo. "Danieli Q-Reg regulator helped us with the elec-

tric power consumption. Another advantage is that the regulator has a very user-friendly and intuitive interface, which facilitates analyses and corrections."

Felipe das Dores Machado. "As a consequence of transparency, speed and interest in carrying out a good job, we were able to perform the start-up in a short time and with minimal impact on our process. Based on the qualitative analysis, immediately after using the Q-Reg regulator, we observed a visible improvement in electrode stabilization during the melting phase, an increase of electric power that ensures a PowerOn reduction of 2.7 min/run."

Bruno Veiga Fontana. "With the new regulator, we had a significant reduction of panel heating, as well better operational safety conditions. All this is combined with a modern and user-friendly work layout."

Anderson Araújo. "We were able to reduce the trips' PowerOff by approximately 20%. The possibilities for adjustment and data analysis, and adjustment reliability give a huge expectation of performance increase."

Manuela Arend Prediger. "The solution that was implemented speeds up decision-making for process improvements and helped in dealing with failures. Moreover, the technical support of Danieli specialists has been fundamental to adjusting the regulator in order to find the potential gains that the equipment can provide to the process."

Gerdau Brasil benefits from the local assistance and maintenance services of Danieli do Brasil.



The Q-Reg electrode-control system allows excellent performance improvements in all the Brazilian installations (Picture: Danieli)

| Danieli

NEW GENERATION SCANTROL™ 4.0

Automatic and continuous refractory maintenance system for the EAF

The SCANTROL system has eliminated the disadvantages and inherent in intermittent refractory maintenance and follows the “No person on the floor” safety principle. Its functionality has significantly improved productivity, working conditions and decision-making capabilities for steel operators.

Continuous changes in the economic environment and the increasing number of EAF plants accompanied by competitive pressure require steel producers to introduce innovative measures to reduce costs, CO₂ emissions and improve safety. Refractory application is a major cause of downtime at EAF plants. This included both the furnace re-lining and refractory maintenance by both gunning and fettling.

The classic gunning maintenance practice involves very hard manual labour to operate by hand lance in front of the furnace, which requires two operatives. Already in 2003, the first fully automatic refractory maintenance system was installed in a German steelplant by Minteq®. From then until today, a lot has happened technologically in laser scanner technology and repair gunning robots. Today a modern maintenance system for refractory lining consists of four main components.

- LaCam® Laserscanner measures the residual refractory thickness of the furnace.
- SCANTROL™ interface module linking the above-mentioned components to evaluate the measurement data, analyse the application strategy and control the robotic maintenance unit.
- MINSCAN™ robotic maintenance system to repair the refractory lining in different areas of the EAF.
- High temperature video cameras provide additional safety, improved performance, and visual inspection capability.

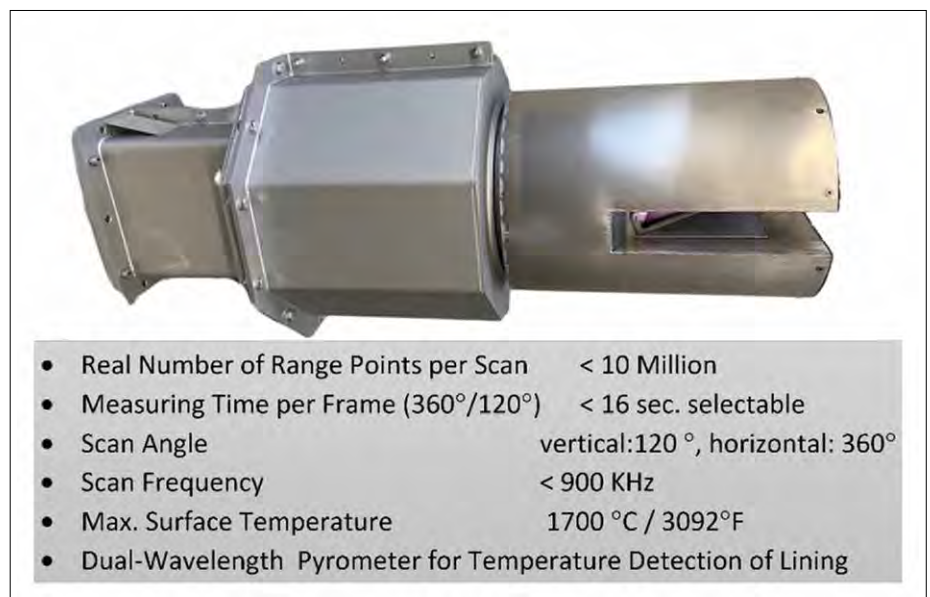


Figure 1. Technical specification of the 5th generation LaCam® laser scanner with protection enclosure (Picture: Minteq)

These four components are combined in a mechanical robot system the LaCam®-MINSCAN™ manipulator. The gunning materials which are stored in silos and transported by batchguns into the MINSCAN™ are specially engineered for improved flowability, wettability and plasticity. The unique particle sizing and binder package allows outstanding adhesion to the furnace substrate, thus improving on-wall density and minimising rebound. As a result, material durability is increased which, in turn, reduces maintenance operations and increases furnace availability. The individual components and their functionality are explained below.

LaCam® 3D laser scanner (5th Generation)

The 5th generation of LaCam® laser scanners (**figure 1**) for metallurgical vessels (i.e. basic oxygen steelmaking furnaces, electric arc furnaces, steel ladles, torpedo ladles) is designed to measure the refractory lining from the inside of the metallurgical vessel, by inserting the laser head into the metallurgical vessel itself, or by bringing it very close to its opening. A huge improvement is that the laser scanner is inserted into the metallurgical vessel and scans the wall and at the same time the bottom of the vessel with a 360° rotation.

Rolf Lamm, Global Director Equipment and MD, Minteq International GmbH, Ferrotron Division, Duisburg, Germany –
Contact: rolf.lamm@mineralstech.com



Figure 2. MINSKAN™ gunning head in operation (Picture: Minteq)

The laser scanner, using the time-of-flight principle (TOF), sends out a series of short laser pulses organised in a highly collimated beam, in a well-defined direction. The pulses are partially and diffusely reflected by targets and the receiver gathers backscattered optical echo signals and converts them into electrical signals. The receiver's electronics detects the targets even in the presence of dust and smoke thanks to the echo digitisation with full waveform analysis (DSP-Technology).

As a result, the distance between the scanner and the target points is computed with high accuracy. Additional measurement values, like laser echo amplitude and surface heat radiation, are recorded for each measurement point too. The heat radiation is measured at two separate wavelengths, which allows to take the full advantage of the high measurement accuracy offered by the two-colour (ratio) pyrometry. In combination with a high-sensitivity long-wavelength channel, a wide temperature range between 500°C (932°F) and 1700°C (3092°F) can be measured accurately and displayed in the form of a high-resolution thermographic image.

The laser scanner needs for a complete measurement scan with up to 10 million measuring points only 16 seconds. In this short time, one gets an entire lining profile of the furnace with a high density of measured points.

MINSKAN™ gunning head

The gunning head can perform a continuous 360° rotational and simultaneous vertical movement from the furnace centre to the upper edge of the furnace water-cooling panels (**figure 2**).

Incorporated inside the gunning head is an eccentric jet mixing Minteq®'s patented nozzle designed to thoroughly wet the material at high speeds whilst preventing clogging and pipe drip. The gunning capabilities are up to 250 kg/min wet material and up to 350 kg/min dry material. Advanced cooling technique ensures that the maintenance operation can operate continuously without any temperature restrictions. Maintenance of EAF is possible immediately after tapping and even possible with remaining steel in the furnace. The system enables precise, efficient, safe, and fast application of the gunning material.

LaCam® – MINSKAN™ manipulator

Two types of design are available: a system where the laser scanner and the gunning head are mounted on the same manipulator arm, which is attached to a tower column), and a solution where one tower column supports two independent manipulator arms. Depending on the location and available space the selection is made. In both alternatives is the tower column located next to the furnace on the

ground. The one manipulator arm set up with main components is shown in **figure 3**. The compact design does not require a big footprint on the floor.

High temperature video cameras

During the gunning process, four video cameras film the performance of the gunning mix application. This provides additional quality control.

Interface between laser and manipulator: Scantrol™

The SCANTROL™ interface module converts the measurement data from the laser scanner in such a way that this information is evaluated, and a maintenance strategy is derived from it to control the robotic maintenance unit (**figure 4**).

Evaluation

The operator at the EAF triggers the measuring process. After the exact position of the furnace has been automatically determined from the laser measurement by means of 3D structure, the working lining measuring points are filtered out and transformed into a coordinate system for the furnace. The calculation of the residual brick thickness is based on a comparison profile (permanent lining). The individual measurement points in high-resolution sub-

fields, defined by cylindrical coordinates and evenly distributed over the area of the vessel potentially to be repaired, are then merged. The system determines the coordinates with minimum residual thickness in relation to sectors displayed in three dimensions. Based on thresholds defined by the operator for the allowable residual wall thicknesses per sector, the matrix of areas in need of repair is derived where the residual wall thickness is less than the respective threshold. The operator sets the optimisation sequence (duration, material consumption, degree of restoration) and starts the calculation of the optimised maintenance procedure so that the system carries out the maintenance automatically:

- › Special matrix formulas combine the fragmented, high-resolution structures of the fields to be repaired into three-dimensionally coherent, compact structures.
- › The size and sequence of the rectangular areas to be repaired, as well as the type of repair materials and the application quantity (application thickness), are determined using strategies for optimizing the time required, material consumption and degree of restoration, and considering the physical properties of the mixtures used for the repair (application from bottom to top, setting time, maximum application thickness).
- › The manipulator coordinates for the areas to be repaired are transmitted to the PLC unit of the MINSCAN™ system in the form of a telegram.
- › The MINSCAN™ system performs its maintenance routine fully automatically, i.e. the correct product is applied "expertly" at the exact location in the desired layer thickness.

These parameters are integrated in the preventive maintenance programme, thereby harmonising consumption, and operating efficiency.

Visualisation

A monitor in the control pulpit is used for the visualisation of the measured residual refractory thicknesses and the parameters for the fully automatic maintenance process in the EAF. The measured residual refractory thicknesses are shown in the left-hand half of the display (figure 5). Visible on the right-hand side are the maintained areas or the thicknesses of the



Figure 3. One manipulator arm set up (Picture: Minteq)

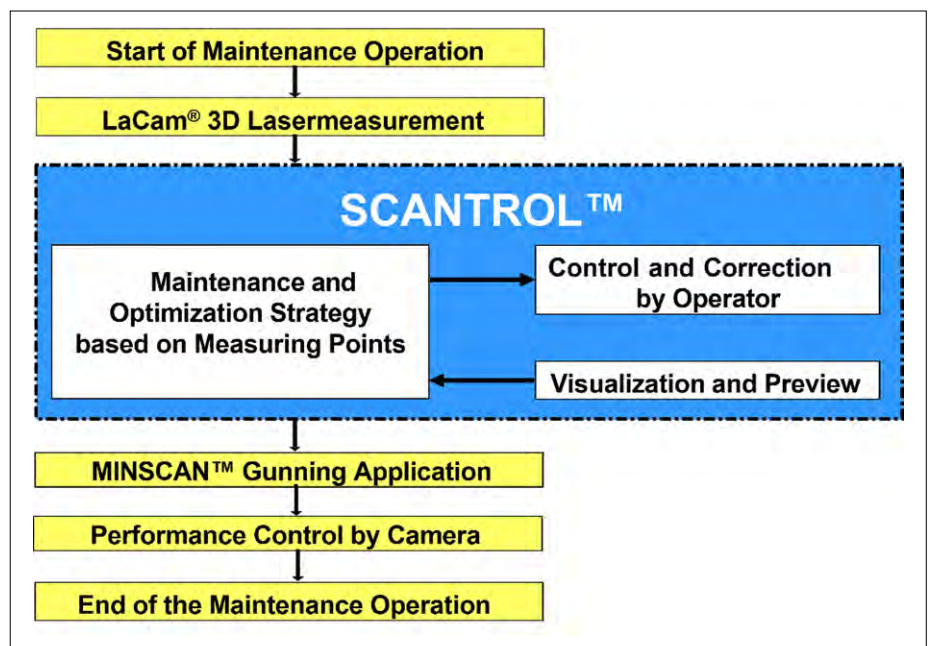


Figure 4. The maintenance process including Scantrol™ (Picture: Minteq)

refractory after a pre-calculated, automatic maintenance process.

Here you can also read the proposed repair product, the required amount and the time needed for the application of the mass. The operator has the possibility at any time to adjust the maintenance process to the situation at the furnace. If he agrees with the proposed procedure, he can trigger the fully automatic repair from the control station. The exact measurements of the residual thickness in the whole furnace provide the operator with versatile information about the state of the refractory in wall

and bottom. Profiles of the refractory wear in the EAF are being determined and evaluated online. The various colours symbolise the diverse residual thicknesses. Horizontal or vertical sectional images can be displayed at all angles (figure 6).

Conclusion

The new generation of automatic and continuous refractory maintenance system SCANTROL™ 4.0 for the EAF takes subjectivity in gunning away from the operator as material applications governed by quantita-

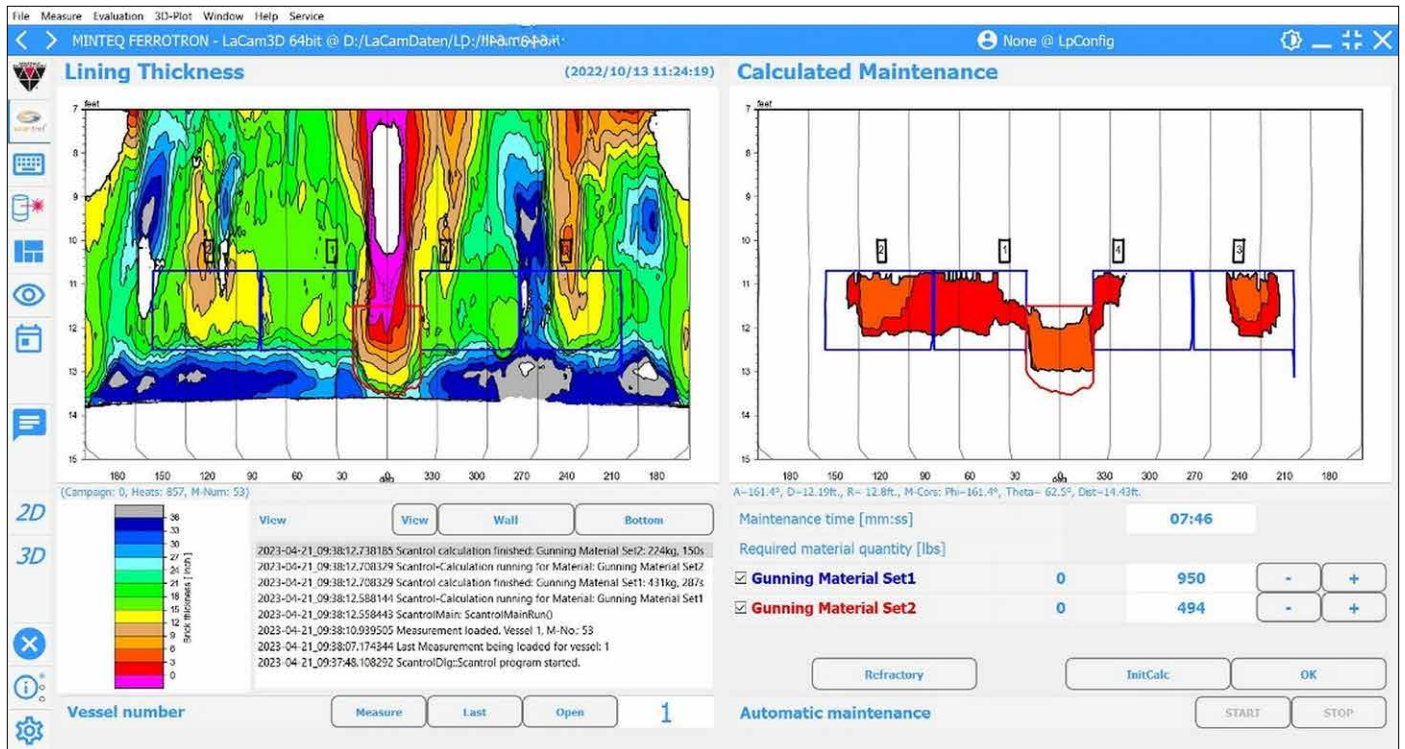


Figure 5. Main screen of SCANTROL™ (Picture: Minteq)

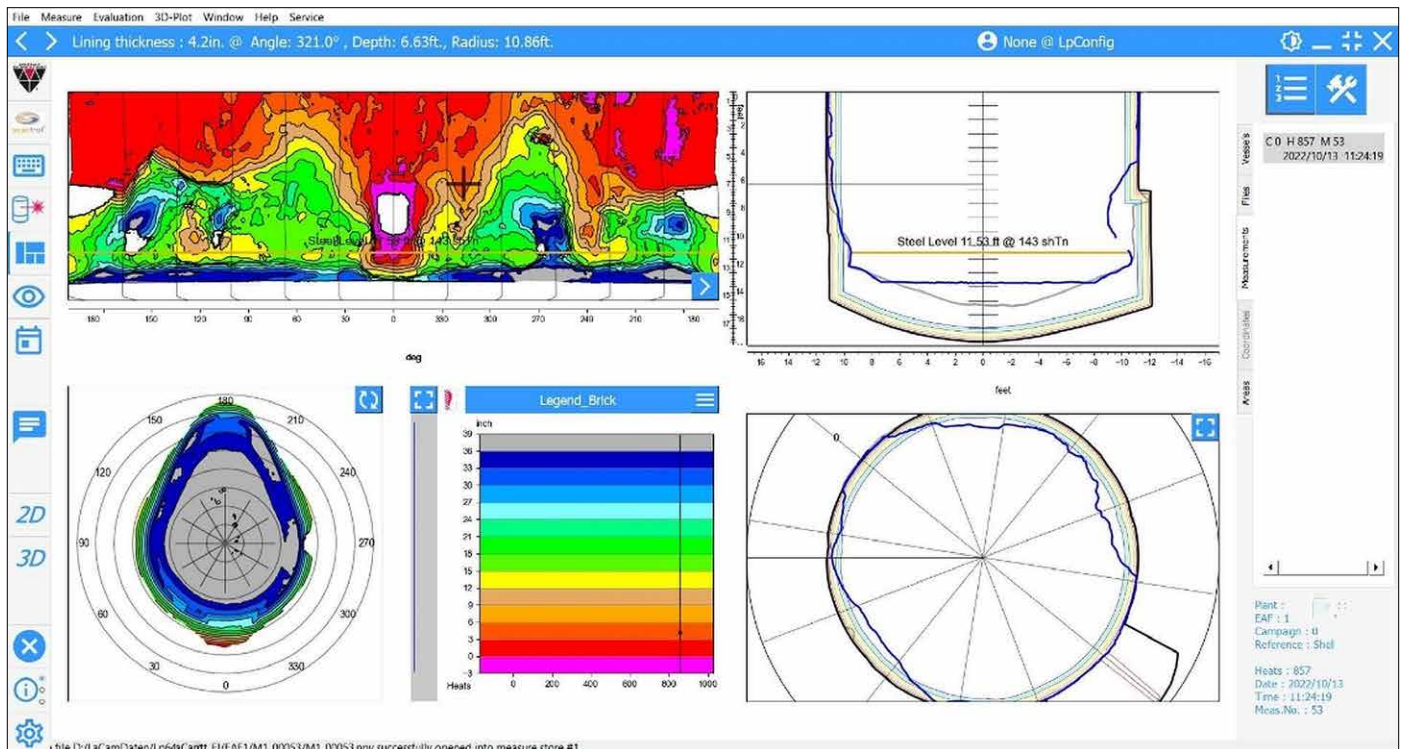


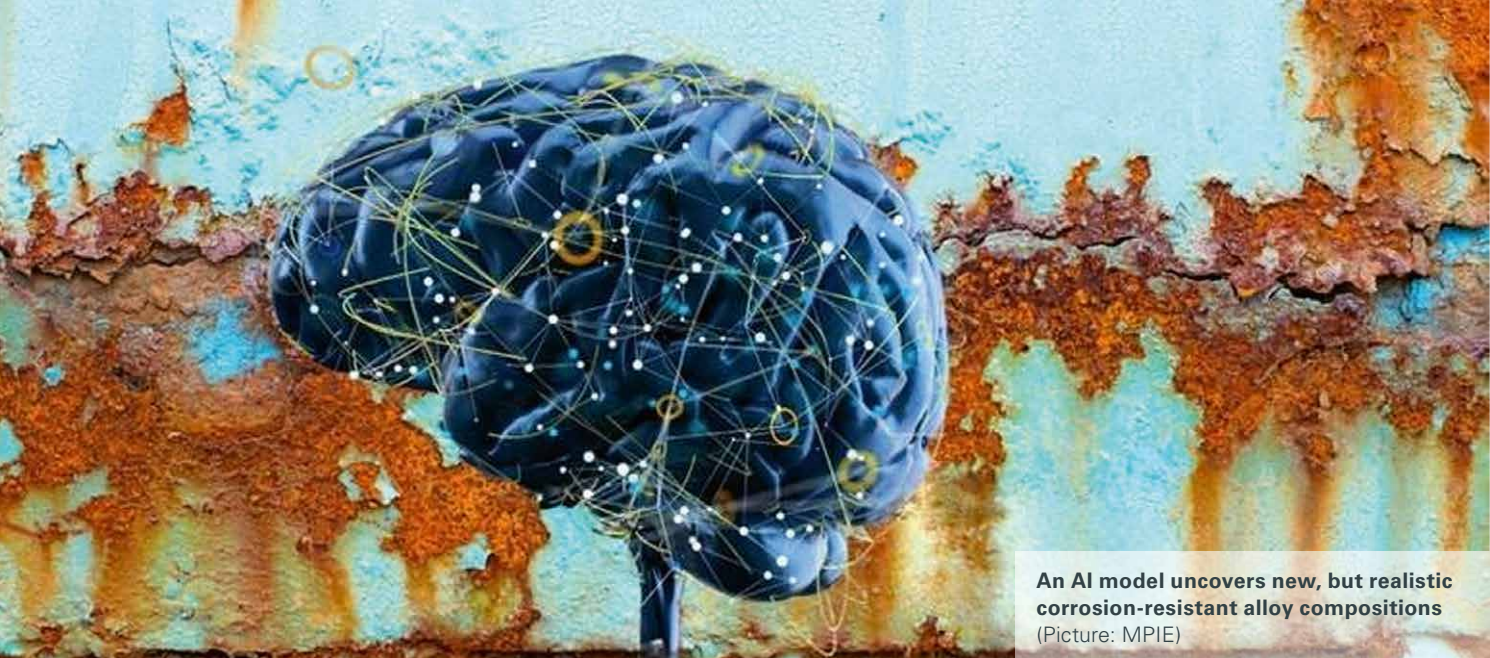
Figure 6. Presentation of measurement results (wall, bottom) in different form (Picture: Minteq)

tive laser measurements. This more efficient refractory application reduces number of bricks relines and patches. It reduces the repairing time and refractory (kg/ton of steel) consumption. It provides increased furnace availability by reducing “power off”

delays. Extra power-on time leads to increased heats and steel production. Due to remote operation safety conditions will improve – “No person on the floor” philosophy. Collecting and analyzing data from measurement systems and databases

using the Industry 4.0 standards will allow steelplants to optimize production and procurement processes to save on costs for material, energy and CO₂-emissions.

■ Minteq International



An AI model uncovers new, but realistic corrosion-resistant alloy compositions (Picture: MPIE)

BASIC RESEARCH

Artificial intelligence used to design advanced metals

Scientists of the Max-Planck-Institut für Eisenforschung pioneer new machine learning model for corrosion-resistant alloy design

In a world where annual economic losses from corrosion surpass 2.5 trillion US Dollars, the quest for corrosion-resistant alloys and protective coatings is unbroken. Artificial intelligence (AI) is playing an increasingly pivotal role in designing new alloys. Yet, the predictive power of AI models in foreseeing corrosion behaviour and suggesting optimal alloy formulas has remained elusive. Scientists of the Max-Planck-Institut für Eisenforschung (MPIE) have now developed a machine learning model that enhances the predictive accuracy by up to 15% compared to existing frameworks. This model uncovers new, but realistic corrosion-resistant alloy compositions. Its distinct power arises from fusing both numerical and textual data. Initially developed for the critical realm of resisting pitting corrosion in high-strength alloys, this model's versatility can be extended to all alloy properties. The researchers published their latest results in the journal *Science Advances* [1].

Merging texts and numbers

“Every alloy has unique properties concerning its corrosion resistance. These properties do not only depend on the alloy

composition itself, but also on the alloy's manufacturing process. Current machine learning models are only able to benefit from numerical data. However, processing methodologies and experimental testing protocols, which are mostly documented by textual descriptors, are crucial to explain corrosion,” explains Dr. Kasturi Narasimha Sasidhar, lead author of the publication and former postdoctoral researcher at MPIE. The researcher team used language processing methods, akin to ChatGPT, in combination with machine learning (ML) techniques for numerical data and developed a fully automated natural language processing framework. Moreover, involving textual data into the ML framework allows to identify enhanced alloy compositions resistant to pitting corrosion. “We trained the deep-learning model with intrinsic data that contain information about corrosion properties and composition. Now the model is capable of identifying alloy compositions that are critical for corrosion-resistance even if the individual elements were not fed initially into the model”, says Dr. Michael Rohwerder, co-author of the publication and head of the group Corrosion at MPIE.

Pushing boundaries: automated data mining and image processing

In the recently devised framework, Sasidhar and his team harnessed manually gathered data as textual descriptors. Presently, their objective lies in automating the process of data mining and seamlessly integrating it into the existing framework. The incorporation of microscopy images marks another milestone, envisioning the next generation of AI frameworks that converge textual, numerical, and image-based data.

■ *Max-Planck-Institut für Eisenforschung*

Reference

- [1] K.N. Sasidhar, N.H. Siboni, J.R. Mianroodi, M. Rohwerder, J. Neugebauer, D. Raabe: Enhancing corrosion resistant alloy design through natural language processing and deep learning. In: *Science Advances* 9 (2023) eadg7992. DOI: 10.1126/sciadv.adg7992

WIRE ROD PRODUCTS

Endless welding rolling for special steel long-product applications

Results of the fruitful cooperation between the Danieli Research Centre and Feralpi Caleotto on cold-heading steel and high-carbon grades

One of the latest, most significant Danieli innovations in the field of long products is the “Endless Welding Rolling” (EWR) process, for the production of straight and spooled bars in coil. EWR billet welding, through automated flash welding, is applicable to billets at the reheating furnace, at the induction heating exit side, or as they come directly from continuous casting machines, making endless rolling possible. Straight and deformed bars, spooled bars in coil and wire rod can be produced by fully exploiting the continuous casting-rolling process and associated advantages, such as improved rolling process stability, and yield, because of intermediate billet-head and -tail cropping.

Currently, this process is widely used to produce rebar for concrete reinforcement, thus carbon steel. Recently, the fruitful cooperation between Danieli Research Centre and Caleotto, part of Feralpi Group, showed that it is possible to expand the scope of EWR applications for some special steel wire rod applications, as proven by rolling at Caleotto’s mill.

Endless Welding Rolling state of the art

Today, effective solutions are available to increase productivity and efficiency in rolling mills for long products, and to reduce production costs considerably. Therefore, Danieli developed and optimized two systems aimed at continuous production of spooled coils, which are the Endless Welding Rolling and the Spooler Line processes. Danieli’s experience in these technologies started in 1995 with the first prototypes of EWR. Today, the sixth-generation billet



Figure 1. Horizontal billet welder in operation (Picture: Danieli)

welding machine, called Horizontal Billet Welding – HBW for short – is ready and widely used by many customers.

All this is possible because the endless welding process eliminates inter-billet time, bar head and tail cropping during rolling, as well as short bars in cooling beds for bar mills and coil trimming in wire rod production. As a result, the possibility of cobble is minimized and maintenance, spare parts and consumables demand are reduced significantly, leading to production cost savings.

The process also becomes very interesting for special steel wire rod production because it’s possible to produce

“customized weight” coils and grant consistent shape and reliable quality, contributing to enhanced product marketability. Furthermore, extra-high coil weights can be obtained, as explicitly required by markets with elevated manpower costs, even when using low-weight starting billets. The stability and reliability of the welding process has been amply demonstrated and tested both in laboratories and in production for rebar and low-carbon grades, but the behaviour of special steels treated with an inline welding process had not been approached in a structured manner until now, by applying it robustly to an industrial process.

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Special steel

To test the special steel products, two grades were selected, a high-carbon grade and a cold heading steel. Both grades are part of the Caleotto product mix, commonly produced at this facility and by many special steel manufacturers. These grades require product quality control regarding surface discontinuities, surface decarburization, mechanical characteristics, and macro- and micro-structure. These characteristics are not only linked and fixed to the international standard requirements, but usually there are also specific restrictive indications from the final user.

Typically, the market standard for wire rod requires no surface discontinuities with depths greater than 0.15 mm, and for some applications and requirements the acceptable limit is even lower. Another key requirement is the surface decarburization of the final product, where complete decarburization is not allowed (pure ferrite) and partial decarburization (ferrite-pearlite) for the high-carbon grades may be allowed by a limit value $\leq 1.0\%$ of nominal diameter, or 0.7% for cold heading steels.

Concerning the requirements (as reported in ISO 16120-4:2017) for the steel grades containing more than 0.40% carbon and wire rod diameters not exceeding 16.0 mm, the microstructure shall consist of a uniform pearlite, with a maximum resolvable pearlite of 30% for C content $0.40 < C < 0.70$, and 25% for C content $0.70 < C \leq 0.80$. Moreover, for grades without an intentional addition of Cr, the microstructure shall be free of martensite and bainite areas.

For the steels considered in the study (as reported on relevant standard ISO 16120-4:2017), the permissible variation for ultimate tensile strength of the wire rod is ± 100 MPa within a batch mean, and ± 60 MPa on coil-to-coil and within-coil variation. These are the general guidelines, although it is not uncommon for wire rod buyers to make special requests not subject to relevant standards. Following here are some examples with an impact on the study.



Figure 2. Billets after welding

- › Many of Caleotto customers' technical specifications request the total absence of welds on the supplied product.
- › Most final applications that require the use of a "continuous wire rod", for example the preliminary drawing to the stranding of wires for prestressed concrete (CAP), are produced by welding the ends of two coils. This welded portion will then be removed by cutting a portion of the rope.
- › For some applications, such as prestressed concrete (CAP) or soft drawing steels, Caleotto must increase the weight of the coil to streamline all downstream processes. Process costs, such as for pickling, acid neutralization, phosphating and soaping/polymer surface treatments, are strongly impacted by the weight of the coil. Note that the drawing processes also would be significantly impacted by an increase in the roll weight, as fewer welds mean less scrap. Furthermore, for some applications where the product is submerged and passes to a reel,

the wire rod clearly defines the size of the reel which is often preferred to be heavier.

Billet preparation

At Acciaierie di Calvisano (IT) – part of Ferapli Group – nine billets were cast for each of two different, special steel grades, C35CrB and C82D, 160x160 mm square and 3 m long, and then heated and welded at the Danieli Research Center facilities (IT). In particular:

- › C35CrB (according to UNI EN 10263-4:2018 / Steel rod, bars and wire for cold heading and cold extrusion) is a typical wire rod grade with very high plasticity and deformability, suitable for cold or hot heading, recognized for good surface quality, ductility and micro-purity. It is used to produce nuts and bolts for the automotive industry.
- › C82D (according to ISO 16120-2:2017 / non-alloy steel wire rod for conversion to wire) is a high-carbon grade with high drawability, distinct micro-structural homogeneity, and excellent micro purity. It is a grade

Table 1. Chemical composition of tested material (% wt.)

	C	Mn	Si	P	S	Ni	Cr	Cu	Mo	V	Ti	Al	B
C35CrB	0.41	0.66	0.08	0.011	0.001	0.05	0.27	0.062	0.009	0.0042	0.050	0.033	0.0040
C82D	0.89	0.67	0.20	0.014	0.005	0.04	0.09	0.052	0.006	0.0018	0.001	0.031	0.001

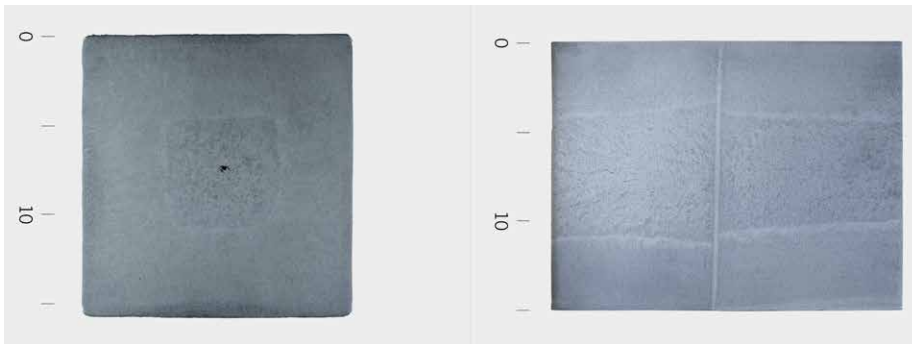


Figure 3. Internal joint status of C35CrB for (left) transversal section and (right) longitudinal section of joint portion

suitable for producing high-strength wire, and intended for manufacturing of strands, braids and wires for prestressed concrete (CAP), or bead wire and hose wire.

The aim was to produce, for each steel grade, three billets, 9 m long and each one containing two welded joints (made by 3+3+3 m). Then, two billets of each steel grade were rolled on the Caleotto rolling mill, and the two joints on the third billet were used to evaluate the starting welding quality.

The heating procedure at the Danieli Research Center was carried out with an off-line induction system in order to reheat both ends (head-tail) and prepare the billet for welding. The target was to reach, for each heating cycle, a final billet-surface equalized temperature of 1100°C. The test began with a pre-heating sequence, then a material pendulum phase under inductor, and finally an equalization phase to guarantee conditions that were most similar to industrial practice in a traditional, gas re-heating furnace, where the thermal exchange is made by radiation and convection due to the burner gasses and furnace walls; or by an induction heating system

usually applied for billets fed directly from the caster to the rolling mill. The surface quality of the billet faces was maintained by oxy-cutting in the casting practice, to guarantee the same operating conditions that exist for industrial operations.

When the material was heated, the two billet pieces were brought, by means of a roller table, close to the machine that performed the welding. The welding procedure is carried out by spark welding. Initially, the two billets are clamped and aligned by the two clamps. Welding takes place by localized melting of the billet surfaces, due to striking of multiple electric arcs and crushing together the billet ends. This operation takes place in three stages:

- Preheating: the relative distance between two billet surfaces is such that an electric arc is triggered.
- Flashing: the surfaces undergo localized melting due to the presence of electric arcs. In this phase, the relative distance between the two billets is automatically adjusted in order to maintain arc ignition and avoid short circuits.
- Crushing (up-setting): the two billets are pressed against each other.

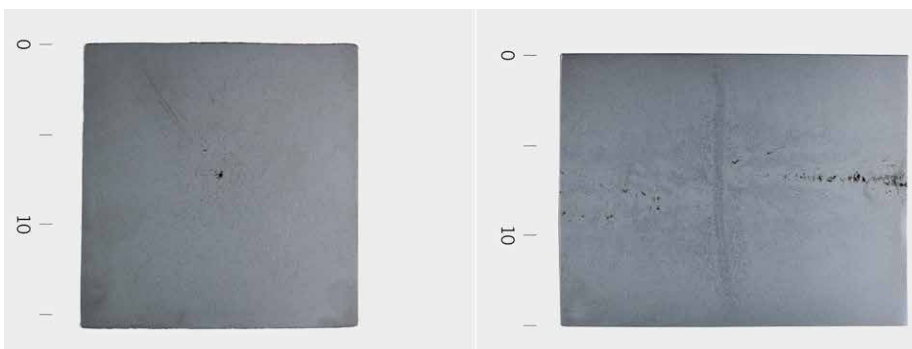


Figure 4. Internal joint status of C82D for (left) transversal section and (right) longitudinal section of joint portion

Test for joint evaluation

Before rolling the welded billets to a final wire rod product, a detailed analysis was performed on the joints to evaluate the material quality. In particular:

- Validation of external surface by liquid penetrant testing (PT),
- Validation of internal joint quality by ultrasonic testing (UT),
- Macro analysis of the joint and billet,
- Micro analysis,
- Chemical distribution of the carbon content and hardness profile.

Liquid penetrant testing (PT). The PT is a non-destructive material testing method that uses capillary forces to find surface cracks or pores and make them visible. It can detect surface-breaking flaws, such as cracks, laps or porosity. The purpose of the specific analysis was to highlight any surface defect that may be caused by the welding process. The following figures show a typical example of the external surface quality of the two grades of the welding joint. The test was conducted after removing the burr, to make it possible to identify the surface and subsurface materials. For each surface of the four billets, visual inspection will not show any relevant unevenness, such as cracks, laps or scratches.

Ultrasonic testing (UT). Ultrasonic testing is a volumetric testing method, similar to radiographic testing. The volume is tested for irregularities or defects that can be detected, including cracks, slag, pores, planar discontinuities and porosity, inclusions and lack of fusions. The aim of this specific test was to evaluate the internal soundness of the welded portion of the billets.

Calibration tests were carried out on a billet section (160x160 mm). Some holes (reference reflectors) were drilled into this calibration sample in order to identify and optimize the scanning procedure to be used.

The calibration tests involved the Time Of Flight Diffraction technique (TOFD), using various types of probes (varying in size and working frequency); and the Phased Array Ultrasonic Testing (PAUT), again testing different types of probes and sockets. Eight scans were taken for each face (scan plane) of the welded billets in the main directions of development. Inves-

tigations showed that the rough solidification structure prevents or significantly reduces the signal when frequencies greater than or equal to 2 MHz are used.

The image analysis was performed with the same sensitivity used to normalize the signal by adjusting the gain (dB), as follows:

- > 32 dB to evaluate the thickness range from 0 to 50 mm,
- > 39 dB to evaluate the thickness range, 51 to 100 mm,
- > 44 dB to assess the 101 to 160-mm band.

For each thickness band, the following details were observed and assessed:

- > The background noise present in areas free from significant indications,
- > The background noise confined to the central zone of the piece, where it should normally be more pronounced,
- > The signal-to-noise ratio,
- > The magnitude of any isolated indications or groups of significant indications.

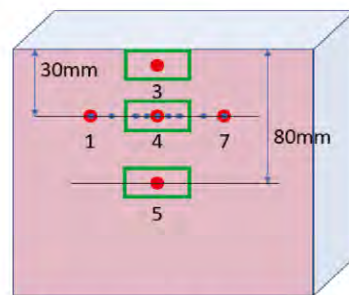
The UT (instrument: Olympus Omniscan X3; probe: Olympus 2.25 DM-A17) showed that there were no significant irregularities introduced by the welding process. The material portion of the welding surface and the heat-affected zone (HAZ) showed the same structural morphology as the rest of the billet, and there was no evidence of embedded material or porosity introduced by the welding process.

Macrographic characterization. Two joints were selected to properly characterize the joint quality, one for each steel grade, and a macrographic characterization was performed after ammonium persulfate etching, for the longitudinal and transversal section (per ASTM E381-22).

In the transversal section (figure 3, left) a central equiaxed zone of about 60 mm

Table 2. Results of LP and UT tests on different welded portions

Steel grade	Billet No.	Weld No.	LP test	UT test
C35CrB	3	3-a	Passed	Passed
	3	3-b	Passed	Passed
C82D	6	6-a	Passed	Passed
	6	6-b	Passed	Passed



- Chemical analysis position of interests (OES)
- Hardness positions of interest (HBW)
- Micrographs position of interest

Figure 5. Position along the billet section of the different tests

square was observed. Central unsoundness is hardly visible, while a center void of about 5 mm diameter is seen. No cracks or other defects are seen in this sample. In longitudinal section (figure 3, right) central unsoundness and some small defects close to the interface between equiaxed and columnar zones are present. In only one side of the billets, central unsoundness and several mid-radius cracks (maximum length about 7.5 mm) are visible.

For the C82D-grade billet transversal section (figure 4, left) no equiaxed/columnar transition was evidenced. Core unsoundness is hardly visible while a center void of about 3 mm diameter is observed. In the sample of the longitudinal section (figure 4, right), diagonal cracks of about 4.5-mm length are observed in the bottom left corner, and central unsound-

ness and central void (maximum width of about 5 mm) are visible. A weak central segregation is also observed, and no cracks are evidenced.

Micrographic characterization. On the same samples, after Nital etching, macroscopic and optical micrograph evaluation methods were applied to define and characterize the microstructure of the welded billets. Up to 10 mm from the surface, the microstructure is mainly pearlitic with allotriomorphic ferrite at the grain boundaries and a few intergranular ferritic grains, either idiomorphic or needle shaped. Prior austenitic grains are coarse and elongated in the solidification direction. Between 10 and 30 mm from the surface, the structure is still composed of pearlite and allotriomorphic ferrite, but a higher amount of intergranular ferrite is observed in figure 6 (left – middle).

At the center of the billet, the microstructure is similar to that observed at 30 mm from the surface, but with heterogeneous distribution of intergranular ferrite. No coarse porosities are evidenced in the sample, figure 6 (right). At high magnifications, TiN is observed in the three positions and micrometric porosities are evidenced at 30 mm from the surface and in the center of the billet. The micrographic analysis did not reveal the presence of oxide deposits at the porous edges or critical macro-defects (if present in the weld area): this suggests effective cleaning of the two billet surfaces in the flashing phase.



Figure 6. Macroscopic view of metallographic specimens of C35CrB; left: at surface, middle: 30 mm from surface, and right: 80 mm from surface (1/2 L of billet, core)

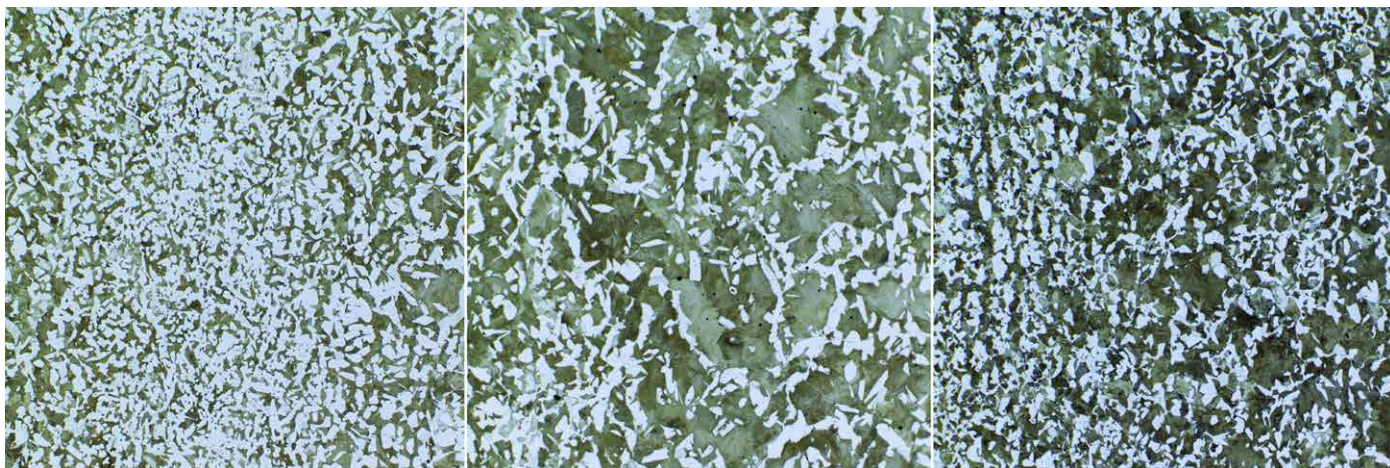


Figure 7. Internal micrograph evaluation near the surface of C35CrB; left: within the welded joint; middle: within the HAZ, and right: in the bulk

In all the reference samples, micrographic reconstructions of the welded billets show just some small defects attributable to central porosity accompanied by microstructural non-homogeneities resulting from localized segregation phenomena. Near the weld joint, decarbonization is more severe.

The micrographic analysis within the welded material, **figure 7** (left), showed a fine microstructure composed mainly of polygonal ferrite and pearlite, with more ferrite than the base material, **figure 7** (right). Coarser microstructure composed of pearlite and ferrite due to the precipitation of primary ferrite at the grain boundaries is noticed on **figure 7** (middle), which is taken in the heat-affected zone (HAZ).

For the C82D sample, the micrographic analysis shows up to 30 mm from the surface a fully pearlitic microstructure, **figure 8** (left – middle). Prior austenitic grain boundaries and the solidification direction are hardly evidenced. At the centre of the billet, **figure 8** (right), the microstructure is mostly pearlitic, but in some areas a white constituent – probably cementite – is observed at the grain boundaries. Coarse central porosities (of a few millimeters) are evidenced in the sample.

Near the weld joint, decarbonization is expected to be more severe in the case of the material with the highest carbon concentration, C82D. Within the joint there is a coarse microstructure composed of pearlite, with the allotriomorphic ferrite present at the grain boundaries, caused by decarburization (**figure 9**, left). Instead, in the HAZ (**figure 9**, middle), decarburization is hardly noticeable (it appears slightly darker) with a pearlitic microstructure near the weld joint, as compared with the core where there is a fully pearlitic microstructure. In the base material (**figure 9**, right) various micro- and macro-porosities are observed, especially in samples taken from the center of the billets strictly linked to central porosity and segregation levels of cast material.

Chemical analysis and hardness profile.

The final tests conducted on the collected joints' samples was evaluated the carbon distribution on the weld material, using Optical Emission Spectroscopy (OES). This test made it possible to evaluate any depletion of carbon due to the melting process and applied temperatures. In addition, a profile of hardness was conducted as per Brinell hardness measurements

(HBW 2.5/187.5) according to NF EN ISO 6506-1:14, on nine positions of the longitudinal section.

In **figure 10**, the blue dots represent the carbon content and surface hardness, while the yellow box represents the average values obtained from a bulk portion of the starting billets, far away from the welded extremities. OES results obtained in sample C35CrB are rather homogeneous, except for carbon content, with a lower value at points 3, 4 and 5, arranged along the welding interface, where a reduction of 12% (-0.05 %wt) is seen. The C82D in **figure 11**, samples show the area near the weld joint where decarburization is more severe, as expected in the case of the material with the highest carbon concentration, with a reduction of around 18% (-0.16 %wt).

Decarburization is followed by a reduction in hardness in the joint area, easily detectable in the case of C82D (drop of 19 HBW on average); while it is less, and not always present, in the joints analyzed in the case of C35CrB (drop of 7 HBW on average). In addition, in the case of C35CrB, a general and uniformly distributed reduction in the hardness value in the joint area (approx. 80 mm) of 35 HBW is

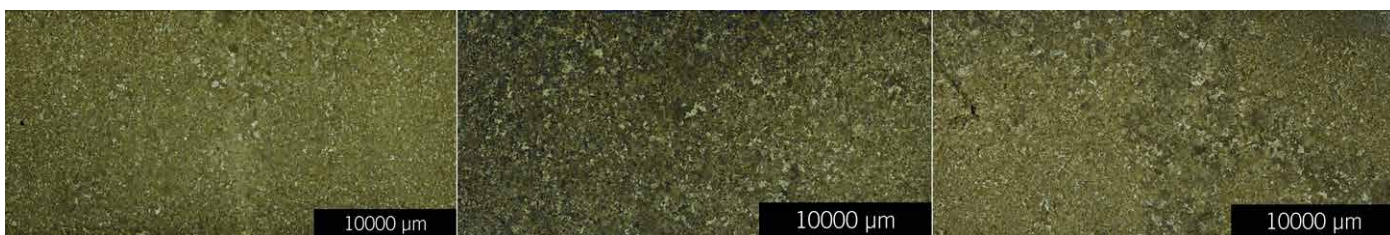


Figure 8. Macroscopic view of metallographic specimens of C82; left: at surface; middle: 30 mm from surface; and right: 80 mm from surface (1/2 L of billet, core)

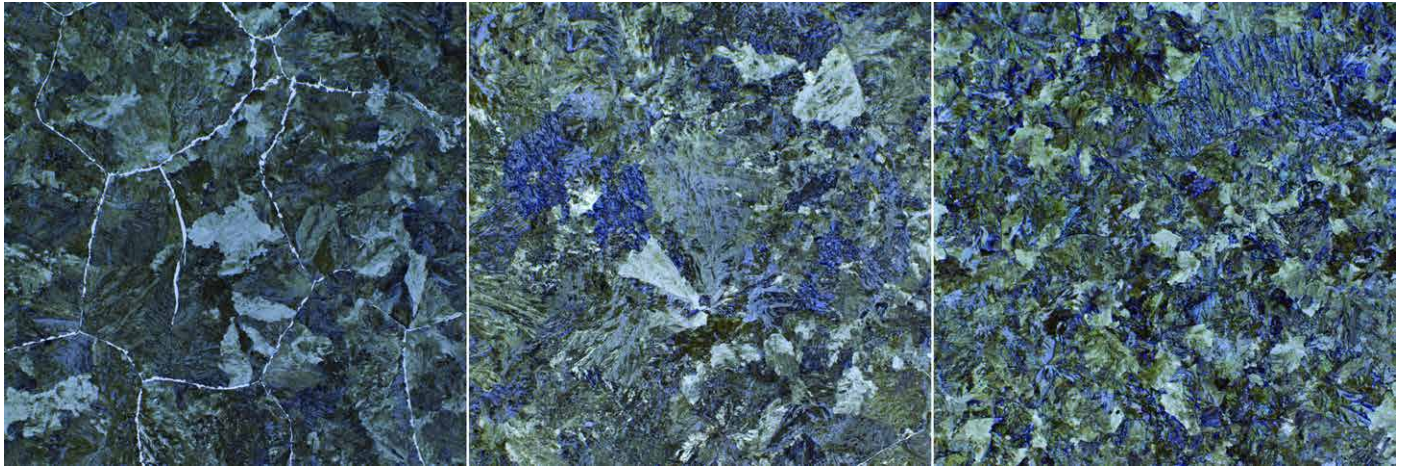


Figure 9. Internal micrograph evaluation near the surface, of C82D; left: within the welded joint; middle: within the HAZ; right: in the bulk

detected. This could be derived from a reduction in segregation, or homogenization, in the C35CrB billet portion, due to billet heating.

Rolling plant

During the tests performed at Caleotto’s facilities, two billets were rolled for each steel grade (C35CrB and D82D), each one 9 m long with two welding joints. First, the semi products coming from the four roughing stands (round feeder of 114 mm) were collected and examined, making a longitudinal section to evaluate product internal quality.

Particular attention was given to the whitish trace line, which represents the sections of the faces of the melt and welded billets. The aim was to highlight not only the discontinuities, if present, but also to define the development of the welded joint. As reported in **table 3**, the length and its morphology were measured after this

preliminary reduction (from square 160 mm to round 114 mm).

As may be noticed, the average maximum thickness of the whitish line is greater for the high-carbon grades (6.5 mm vs. 3.5 mm). This can be strictly linked to the depletion of carbon. The development of the whitish line along the rolling direction, which is the difference between the nearest and furthest points with respect to the rolling direction of the semi product, is similar for both steel grades (15.0 mm vs. 16.5 mm).

Metallurgical and mechanical evaluation on the final product. After analyzing the feeder samples, testing continued with micrographic detail and mechanical property analysis of the finished product, the 13-mm wire rod round. The aim was to identify on the final coil the exact location and development of the joint.

Concerning the metallographic analysis on 13-mm wire rod, for both steel grades

(C35CrB and C82D) no microstructural anomalies or surface defects attributable to the welding process were found on the structure of the samples. The results of the micrographic analysis are directly comparable to the rest of the coil.

The mechanical properties on final product have been analyzed considering the evolution of the joint area and the heat-affected zone (HAZ) along the final product. In particular, on the final coil samples were taken from an 80-m section and analyzed by intensifying the specimen concentration near the welded joint. For all the analyzed samples, and for both steel grades, the values of Rm (ultimate tensile strength), Re (yield stress), A% (percentage elongation after fracture), and Z% (percentage of reduction of area), tested according to EN ISO 6892-1:2009, are in line with the values obtained away from the weld joint (material bulk), except for a few “outliers”, as shown in the following graphs.

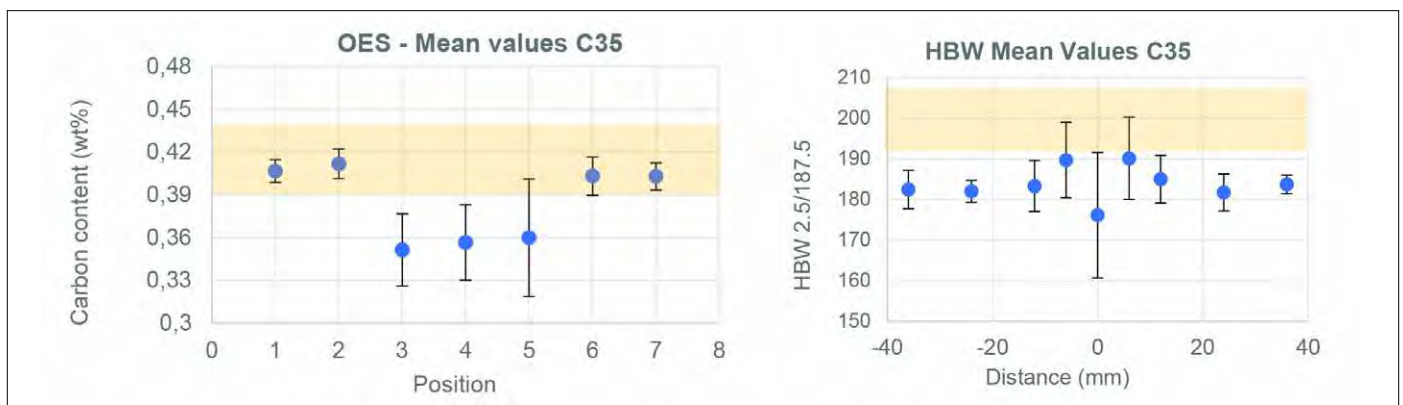


Figure 10. For C35CrB samples; left: OES analysis distribution considering distribution represented in previous figure 5; right: Brinell hardness in the welded joint considering 0 mm the axis of symmetry of the welded joint

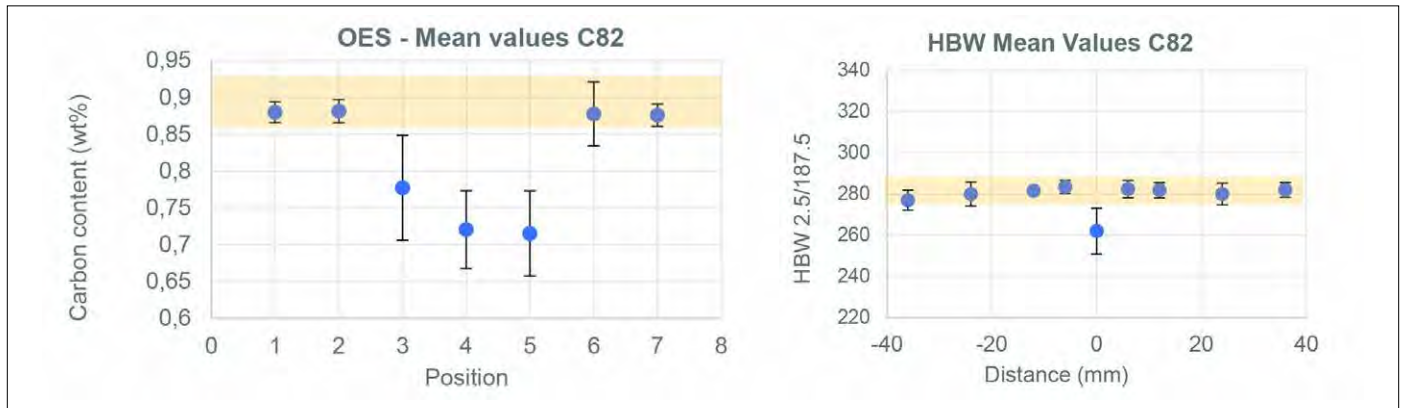


Figure 11. For C82D samples; left: OES analysis distribution considering distribution represented in previous figure 5; right: Brinell hardness in the welded joint, considering 0 mm axis of symmetry of the welded joint

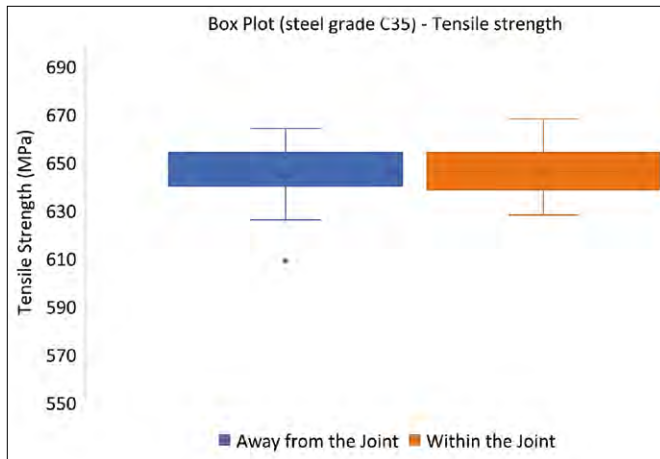


Figure 12. Box plot for C35CrB tensile strength

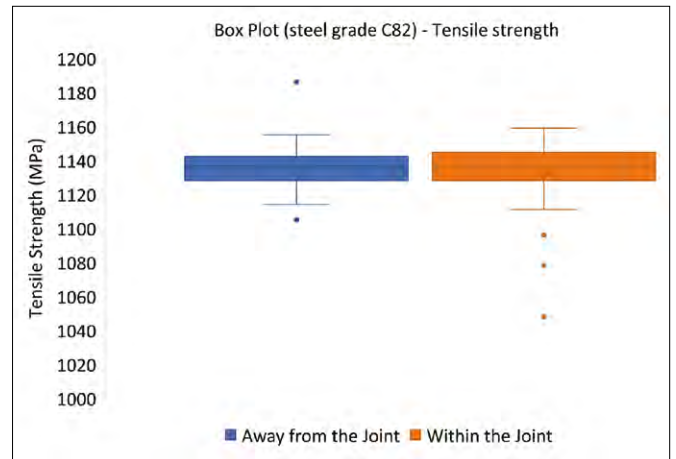


Figure 13. Box plot for C82 tensile strength

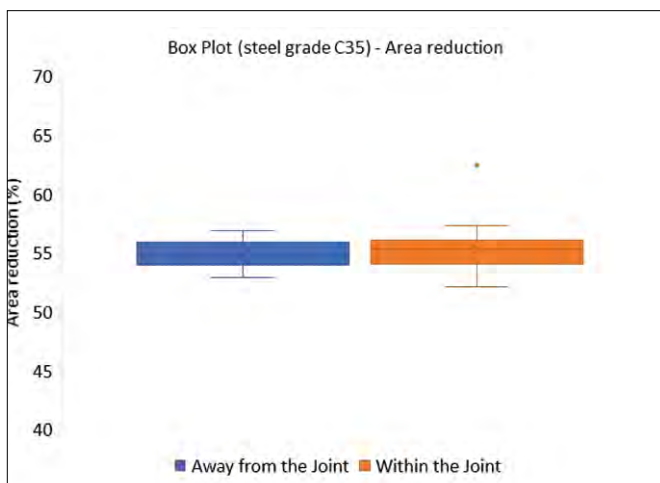


Figure 14. Box plot for C35CrB srea reduction

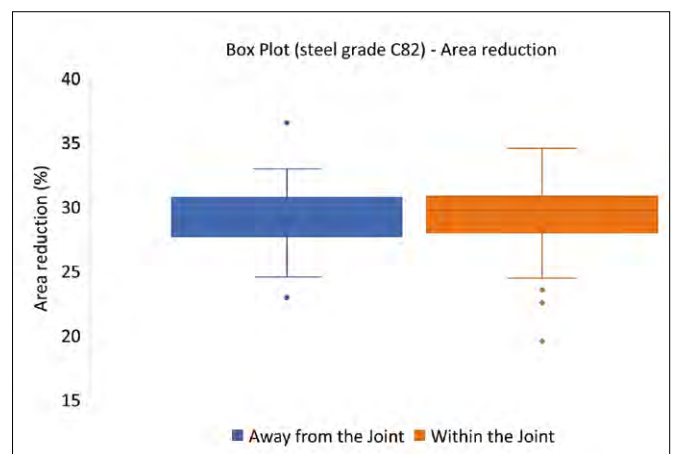


Figure 15. Box plot for C82 area reduction

Table 3. Morphology measurements of the whitish line in the longitudinal section

	Representative whitish line thickness [mm]	Average thickness [mm]	Dimension on max. thickness [mm]	Average on max. thickness [mm]	Development along rolling direction [mm]	Average develop. along rolling direction [mm]
C35CrB	2.0	2.0	4.0	3.5	16.0	15.0
	2.0		3.0		14.0	
C82D	3.0	3.0	6.0	6.5	19.0	16.5
	3.0		7.0		14.0	

After the tensile test, these “outlier” samples were visually analyzed to look for any microstructural unevenness, such as porosity, segregated traces, or exogenous or endogenous inclusions that may have reduced the mechanical performance of the sample. This analysis near the two fracture surfaces did not reveal any particular internal defect that may have been determined to have reduced mechanical properties.

Statistical evaluation. For a more refined analysis, in order to better highlight the small difference of the mechanical characteristics away from and within the welded joint spread, the graphs in **figures 12, 13, 14, 15** are reported. In descriptive statistics, a box plot is a method for graphically demonstrating the locality, spread and skewness groups of numerical data through their quartiles. In addition to the box on a box plot, there can be lines (whiskers) extending from the box indicating variability outside the upper and lower quartiles. Outliers that differ significantly from the rest have been plotted as individual points beyond the whiskers on the box-plot. The spacings in each subsection of the box-plot indicate the degree of dispersion (spread) and skewness of the data. As can be appreciated, the distribution of the analyzed values, for both grades, away from the joint and those inside the joint, are statistically corresponding and comparable.

Conclusion

This work set out to demonstrate the stability and reliability of the Danieli equipment (Horizontal Billet Welder-HBW) for welding special steel billets. The joint characteristics and the final wire rod product were analyzed for two grades of special steel with commercial applications: a high-carbon grade (C82D) and a cold heading steel (C35CrB).

At the Danieli Research Center, the approach was to demonstrate the properties and characteristics of the starting material joint (made of welded billets), and then to test the final product rolled in normal industrial conditions at the Caleotto rolling mill.

For the joints, a detailed analysis was performed to evaluate the products’ material qualities, in particular the external surface by liquid penetrant testing (PT); the internal joint quality by ultrasonic testing (UT); a macro and micro analysis of the joint and billet; and then a chemical distribution of the carbon content and hardness profile on the welded portion. None of these tests revealed any particular defects or critical discontinuities that could be attributed or associated with the welding process, or that could directly affect the quality of the finished product. An intermediate step was to analyze the feeder of the continuous mill close to the welded joint, in order to assess the development of the welded portion (whitish line).

Finally, metallographic and mechanical characterization (Rm, Re, A%, Z%) tests were carried out on the finished rod products (13 mm rounds) in order to compare the characteristics of the samples taken near the joint and away from it.

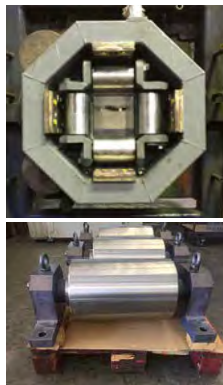
In general, the mechanical and

microstructural characteristics of the finished product can be considered homogenous for both grades, C35CrB and C82D, and it can be stated that the Endless Welding Rolling applied with the Horizontal Billet Welder (HBW) makes it possible to obtain a homogenous product to which no detectable defects, neither internal nor superficial, are introduced. A further step in this analysis will be to test the coils at an end-user’s facility, to follow the entire production chain of these special steel grades.

| Danieli / Feralpi Caleotto

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FIRST BAR ROLLED SUCCESSFULLY

Nucor upgraded engineered bar mill in Nebraska with new rolling technology

A new intermediate block from KOCKS replaces the traditional intermediate mill

Nucor Steel Nebraska, based in Norfolk, is a division of Nucor Corporation that has successfully rolled the first bar on its new intermediate Reducing & Sizing Block (iRSB[®]) from KOCKS in summer this year. The model “3-roll iRSB[®] 370++/8” replaces eight traditional 2-high stands, providing pre-sections in a tandem arrangement for the existing RSB[®] 370/5, which has been successful in operation since 2005.

The newly developed iRSB[®] has been designed to increase flexibility. Additionally, its design minimizes potential trouble spots and improves safety for operators. Nucor’s decision for the iRSB[®] was based on the substantial improvement of the whole rolling mill concept with regard to quality, flexibility, productivity, and process safety. With the KOCKS 3-roll intermediate block, new, more sophisticated material grades can be most flexibly rolled and enhance Nucor’s product portfolio without major changes to the overall layout of the rolling mill.

KOCKS also supplied the roll-shop equipment and its software solutions. Furthermore, the iRSB[®] is equipped with the profile measuring gauge 4D Eagle[®]. It is also connected to KOCKS’ size control system (SCS[®]), which allows real-time adjustments of the operating parameters of the rolling block. This enables transparent process monitoring and the quickest possible process adjustments.

Following the successful commissioning, the Final Acceptance Certificate (FAC) was signed only three weeks after the first bar was produced through the block.

I KOCKS

The intermediate Reducing & Sizing Block (iRSB[®]) represents one of the latest advancements in KOCKS’ long product production technology (Picture: KOCKS)

Nucor Steel Nebraska upgrade project

In May 2021, Nucor Corporation announced a US\$58 million investment project to upgrade the company’s engineered bar mill in Nebraska to better serve the automotive market and continue to meet its customers’ needs for the highest quality products. The modernization project included a new reheat furnace, new intermediate mill (see above), and coil inspection and trimming station.

“The upgrades we are making to our engineered bar mill in Nebraska are part of our efforts to continue to grow the number of tons we sell to the automotive market,” said Leon Topalian, President & CEO of Nucor Corporation. Main target of the upgrade project was the ability to produce engineered bar and coil products with improved surface quality and reduced decarburization, which are required to meet high-end engineered bar automotive applications. This investment should further diversify the products supplied from Nucor Steel Nebraska. Additionally, this project furthers the commitment to safety by allowing Nucor teammates to do their work away from the rolling process. Located in Norfolk, Nucor Steel Nebraska has been operating since 1973 and employs 500 teammates.

I Nucor



QUALITY ASSURANCE

Stabel and reliable measurement even on very high line speeds

The PROFILEMASTER® SPS monitoring system for measuring contours and dimensions on profiles in hot steel applications has been equipped with two additional features, a new generation of high-speed cameras and the new optional surface fault detection algorithm

Due to the continuous success and the growing demand of surface inspection, Zumbach Electronics has launched two new main features on the PROFILEMASTER® SPS product family. The latest generation of high-speed cameras allow the acquisition of full product contours at a rate of 2000 Hz. This allows a stable and reliable measurement even on very high line speeds and challenging products like rebar. In addition, the new surface fault detection algorithm (software option "SFD") also benefits from the faster cameras as smaller surface faults can be detected. It is also possible to inspect any kind of complex products such as rails and profiles.

Since the launch of the PROFILEMASTER SPS family, the monitoring systems have proven their reliability under harsh environments of rolling mills for hot and cold steel rods, bars, profiles and much more. Various models are available with 4 up to 8 laser/camera modules and different measuring field sizes to cover product dimensions from 5 mm (.2 inch) up to 720 mm (28.3 inch). All relevant dimen-

sions such as width, height, angle and radius or other geometric characteristics are displayed in an operator-friendly graphical user interface. Changes in speed and

twist within normal limits have no influence on the measurement precision.

■ *Zumbach Electronic AG*



PROFILEMASTER SPS 80 measuring unit (Picture: Zumbach)

Main features of the PROFILEMASTER SPS

- › Provides 100% inspection in real time
- › Reduces start-up time
- › Increases the repeatability and precision of your end product
- › Improves process control
- › Reduces scrap
- › Saves raw material and post processing costs
- › Detects process problems at an early stage
- › Integrates in a seamless way to network or higher-level systems
- › Simple cleaning requirements, giving short maintenance needs
- › Logging of all production data for QC department
- › Makes post-production measurements irrelevant
- › Surface fault detection (SFD) thanks to high sampling rate
- › Compilation of a 3D model thanks to high sampling rate
- › Reliable operation in harsh conditions, product temperatures up to 1,200°C



63,300 visitors from 114 countries came to the world's leading trade fairs GIFA, METEC, THERMPROCESS and NEWCAST in Düsseldorf (Photo: Messe Düsseldorf / CT)

EXHIBITION SUMMARY

METEC & THERMPROCESS trade fairs dominated by energy transition issues

Top results, top-level discussions and top atmosphere at the Bright World of Metals in Düsseldorf in June

After five eventful trade fair days, Messe Düsseldorf as organiser was visibly satisfied. 63,300 visitors. In terms of numbers, this is almost 13 per cent less than at the previous event (2019: around 72,500 trade visitors). The pandemic of the previous years was probably still having some effect. Trade fair quartet scores points with 69 per cent international attendance including strong overseas

Around 2,200 exhibitors from 56 countries presented the power of the metallur-

gical industry and set forward-looking impulses with their machines, plants and solutions. Sustainability and artificial intelligence were much-discussed topics in the twelve exhibition halls of the four world-leading trade fairs. Investment, also in challenging times for the global economy, spontaneously successful business deals as well as a vivid exchange amongst all parties involved characterised the dynamic atmosphere on the entire fairgrounds. 78% of visitors are planning con-

crete investment over the next two years. The share of decision-makers among the fair visitors was 58%.

"Especially in times of sustainable change it is as important as ever to be present here in Düsseldorf and in direct exchange with industry players in order to demonstrate strength in a forward-looking market environment. With their international appeal and high-quality trade audience GIFA, METEC, THERMPROCESS and NEWCAST provided excellent oppor-



Exhibitors from 56 countries presented the power of the metallurgical industry and set forward-looking impulses with their machines, plants and solutions (Photo: Messe Düsseldorf / CT)



Digitalisation, the circular economy and new technologies dominated the action in the exhibition halls and in the accompanying supporting programme (Photo: Messe Düsseldorf / CT)

tunities to do so," says Bernd Jablonowski, Executive Director at Messe Düsseldorf, summing up the results of the trade fairs.

The trade fairs proved again even more internationality in terms of both exhibitors

and visitors: 76% of the exhibiting companies came from abroad. For visitors this percentage stood at 69% with a large share from Asia and overseas. "Trade fair at last!" was a sentence frequently heard

in the halls, because after four years the international community was able to network again face to face. This underlines the very positive mood in the exhibition halls.



With almost 550 lectures, ESTAD was once again the largest steel conference in Europe (Photo: Messe Düsseldorf / CT)



For the first time, a top-level meeting between leaders of the industry sectors and Mona Neubaur, Minister for Economy, Industry, Climate Protection and Energy of the State of North Rhine-Westphalia, took place during the fair (Photo: A. Hannewald)

“GIFA, METEC, THERMPROCESS and NEWCAST are covering almost the entire international market,” says Malte Seifert, Director at Messe Düsseldorf. The demand for European metallurgy and foundry technology is especially high overseas – and here particularly in India, the USA and China. This is also reflected by the international ranking of countries: here India and the growing market Turkey rank first – followed by Italy, China and France. “This high international attendance on both the exhibitors’ and visitors’ part is a key guarantee for the success of the Bright World of Metals making this trade fair quartet so unique. For metal and foundry professionals from all over the world GIFA, METEC, THERMPROCESS and NEWCAST are an absolute ‘must’,” adds Seifert.

Industrial transformation as a ‘signpost’

Current market developments, enormous challenges such as (skilled) labour shortage, extremely high energy costs that are putting a special burden on German companies, but also the opportunities that the energy transition is bringing – there was a plethora of dominating topics featured at the Bright World of Metals. Possible solutions such as the introduction of an internationally competitive electricity price for industry, for example, were discussed on

the first day of the trade fair in a top-level talk between the leading minds in the industry and Mona Neubaur, Minister for Economy, Industry, Climate Protection, and Energy in North Rhine-Westphalia. These topics also determined the lecture programme of the forums and conferences accompanying the trade fairs. The need for digitalisation and the use of Artificial Intelligence, the will to achieve sustainability as well as changed manufacturing processes are all an expression of the transformation in the energy-intensive industries.

Many ideas and trending themes for a sustainable future

The strategic focus of the Bright World of Metals on the four key subjects sustainability, digitalisation, circular economy and new production technologies determined activities in the exhibition halls and at the side events – such as the conferences and many ecoMetals formats. Some 20 metallurgical industry players participated in Messe Düsseldorf’s ecoMetals campaign. Since 2011 Messe Düsseldorf has already actively supported changing the image of energy-intensive industries towards more sustainability. The fact that the exhibitors at GIFA, METEC, THERMPROCESS and NEWCAST are not only innovative, but are also increasingly producing in an energy-efficient and resource-saving manner,

could be experienced live at the ecoMetals Trails.

The opportunities and chances on the path towards a green transformation were also discussed at the ecoMetals Forum in hall 9. The Forum was organised by VDMA Metallurgy and Messe Düsseldorf for the first time with great success.

Exhibition stands as stages for a multifaceted programme

The big players in the sectors in particular had once again created a separate area on their exhibition stands for a daily programme of papers. Whether at the “Leading Partner Talks” of the SMS group, in the “Green Lounge” of Primetals Technologies or in the “Tenova Areana” - everywhere experts presented new developments or operators demonstrated new technologies that had been installed in the recent past. Interviews and panel discussions were also held here. The range of topics was very diverse and the active format promoted dialogue and exchange with the fair visitors.

The next Bright World of Metals, comprising the leading trade fairs GIFA, METEC, THERMPROCESS and NEWCAST, will take place from 21 to 25 June 2027.

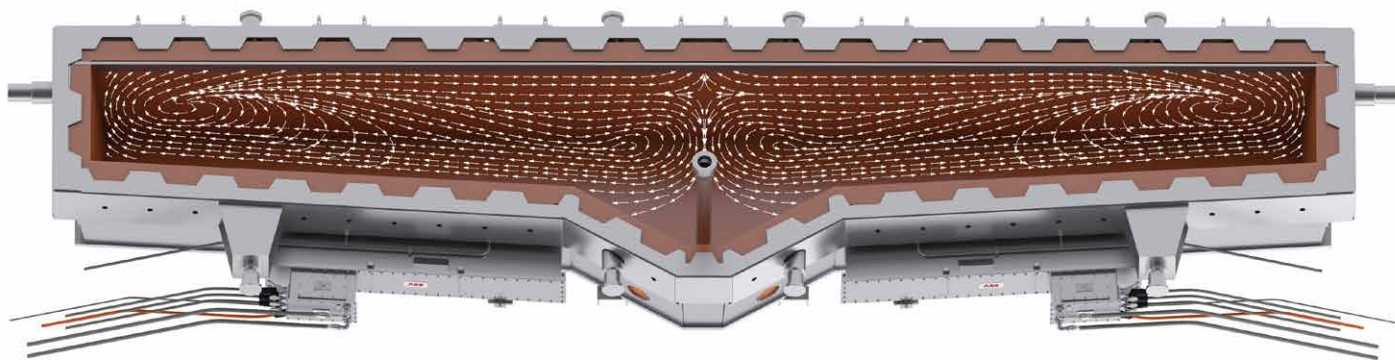
■ *Messe Düsseldorf / STEEL + TECHNOLOGY*

ESTAD conference with 1,300 participants from over 40 countries

The European Steel Technology and Application Days - ESTAD, which took place parallel to the METEC trade fair, was once again the largest steel conference in Europe with almost 550 presentations. Steel experts from 240 companies from 33 countries gave presentations on the topics of ironmaking, stellmaking, rolling and forging, Industry 4.0, advanced steel materials and hydrogen as an alternative resource in the steel industry. Within this broad spectrum of topics, hydrogen-based steelmaking was clearly the focus. This was not only reflected in a dedicated lecture session with over 100 presentations, but also in a full-day keynote session under the motto “The steel industry on the way to green steel”.

With the large number of participants and presentations as well as the broad and modern range of topics, ESTAD was able to continue its success story as the most important European steel conference. In addition, the Steel Institute VDEh as organiser was particularly pleased to have once again given metallurgists and materials engineers from all over the world a platform and a meeting place for exchanging ideas, especially after the pandemic that lasted for years.

■ *Steel Institute VDEh*



Tundish EMS solution will enable steelmakers to control the flow of molten metal better (Picture: ABB)

DIGITALISATION

Artificial intelligence as part of steel industry transformation

AI applications improve forecasting leading to more efficient use of energy for new levels of productivity, quality and yield. ABB has developed products and solutions to help steelmakers drive sustainability and metallurgical improvements.

ABB shared insights on the role of AI applications in supporting steelmakers to electrify, automate and digitalize their operations during the METEC trade fair in Düsseldorf, Germany in June this year. Frederik Esterhuizen, Global Business Line Manager Metals, and Tarun Mathur, Global Product Manager – Metals Digital Portfolio, discussed the use of AI in digital applications to improve energy management in steel mills. The global technology provider showed how better energy forecasting can lessen supply issues and mitigate price peaks.

The presentation titled 'The Role of Artificial Intelligence in Digital Transformation of the Steel Industry' outlined how AI applications can optimize energy purchase and production including at site power plants and turbines. It can assist by-product gas dispatching leading to 10 percent less flaring of gases and improve electricity procurement forecasts by 15 percent. Data and optimization modelling and rule-based energy management algorithms can lead to optimized energy consumption and energy security in operations.

ABB showcased safer and smarter solutions and innovative products and

services for more efficient operations across the metals industry including ABB Ability™ Smart Melt Shop, which enables real-time visualization of equipment movements in steel melt shops and the machine learning thermal model to ensure better superheat compliance resulting in increased caster productivity. Another key technology is ABB Ability™ Advanced Process Control which leverages Model Predictive Control technology to provide 'autopilot' functionality for sintering and pelletizing process stability, improved quality and output, and reduced costs.

Tundish EMS technology

ABB recently launched ABB Tundish EMS, a new electromagnetic stirring solution that enables accurate, homogenous, stable control of steel temperature in the tundish. This tundish-focused technology helps steelmakers increase quality, productivity and profitability in billet and bloom casting and metal powder production.

"The new technology enables steel plant operators to overcome the challenges of controlling flow, steel quality and tem-

perature in tundish not yet solved by furnace systems. It addresses the limited ability of the tundish vessel in controlling the flow of molten metal," ABB emphasises.

Tundish EMS is placed outside the tundish and uses non-contact electromagnetic stirring technology to generate an electromagnetic field that creates a stirring action in the bath melt. This continuous stirring significantly increases mixing zone volume for virtually the entire tundish, with higher flow speeds, elimination of dead zones and temperature homogenisation.

The adoption of this electromagnetic stirring technology will be particularly important for steelmakers with multiple casting strands coming from one tundish. The improved removal of inclusions will result in smoother, cleaner steel and reduced nozzle clogging.

ABB launched the product following a successful pilot project in China in partnership with engineering company Zenith. The process conditions included GCr15 (bearing steel), a casting speed of 0.76 meters per minute and a tundish throughput of 1.25–1.9 tonnes per minute. The results included increased temperature homogeneity in the tundish (a difference of 1.1°C

Frederik Esterhuizen, Global Business Line Manager of Metals and Joachim Braun, Division President of Process Industries, at ABB's stand at the METEC trade fair
(Picture: ABB)



with the EMS vs 2.5°C without) and superior temperature stability during sequence casting (tundish temperature is 6°C lower with the EMS, and the average temperature variation was 2.8°C lower).

"ABB offers the world's most comprehensive range of EMS for both steel and aluminium production processes, delivering metallurgical improvements proven to increase productivity, end-product quality and reduce operating costs for electric arc, ladle and aluminium furnaces, as well as thick and thin slab and billet and bloom casters," the company states.

Low-carbon copper commitment in metallurgy technologies

ABB will purchase low-carbon copper winding wire from global provider Dahrén for use in the manufacturing of its electromagnetic stirring (EMS) equipment. The supplier, which operates primarily in Sweden, Germany and Poland, receives raw copper mined by Swedish mining and smelting company Boliden using fossil-free energy and processes it into wire. Copper is a vital material for manufacturing industrial electrical equipment, but its production is energy intensive. The carbon footprint of the Boliden product used by Dahrén is known to be 65 percent lower than the industry average.

"Through close collaboration with Dahrén and Boliden, ABB is helping to build a supply chain ecosystem with a low-carbon and ultimately a zero-carbon approach at its center," said Ola Norén, Head of Metallurgy Products, Process Industries, ABB. "We are increasing our use of low-carbon and recycled copper winding wire in our EMS technologies all the time."

EMS solutions deliver metallurgical improvements that are proven to increase productivity, end-product quality and reduce operating costs for electric arc, ladle and other electric furnaces, as well

as thick and thin slab and billet and bloom casters.

With over 100 years of experience in the metals industry, ABB's complete range of products, services and end-to-end solutions improves productivity, quality, safety and cost-efficiency in iron, steel and aluminium manufacturing. ABB partners with metals companies at every step of the process from yard to market, whether that be iron or steelmaking, hot rolling, cold rolling or processing lines.

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PLANT ENGINEERING HAS LEFT THE PANDEMIC BEHIND IT

Metallurgical equipment manufacturers are cautiously optimistic about 2023

German metallurgy industry association VDMA Metallurgy presented a comprehensive programme on decarbonization and future technologies at the trade fairs GIFA, METEC, THERMPROCESS, NEWCAST in Düsseldorf. The metallurgical machinery and plant engineering sectors represented by VDMA Metallurgy were cautiously optimistic in the current trade association business survey and expect sales growth in the low single- and double-digit range in 2023.



In the exhibition hall 9, VDMA Metallurgy, partly together with partners, hosted an extensive program of lectures and discussions (Photo: Messe Düsseldorf / CT)

increased by almost 15 percent year-on-year (628 million euros).

Thermoprocess technology exports increased slightly between January and March 2023 (plus 4 percent), after missing the previous year's figure by 3 percent in 2022 (1.67 billion euros). From January to March, the USA and China played the main role in exports – with opposing trends (plus 33 / minus 43 percent).

There were no signs of a turnaround in foundry machinery exports from Germany in the 1st quarter of the current year. Year-on-year, exports were down by a quarter. This development is based on strongly diverging market trends: While exports to Switzerland, the United Kingdom, Hungary and, outside Europe, China and Vietnam increased, exports to important target markets such as the USA and Austria declined. As in the previous year, the EU27 countries purchased less foundry technology from Germany (2022: minus 5 percent).

Industry expectations for 2023

Order entries by foundry machinery manufacturers in the 1st quarter 2023, at plus 5 percent adjusted for price, developed better than the mechanical engineering average. Orders from non-euro countries made a major contribution to this trend. In 2022, orders had declined by 11 percent on a price-adjusted prior-year basis, which was below pre-crisis levels.

The foundry technology participants in the current trade association business survey expect sales growth in the mid-single digits for the entire year 2023.

With a result of plus 1 percent in price-adjusted orders received, thermoprocessing technology is also one of the above-average performing sectors measured against the overall mechanical engineering sector in the 1st quarter of 2023. The year 2022 had closed with a minus of 5 percent in order intake.

In the current trade association economic survey, the participants from the thermo-

processing technology sector expect sales growth of around 10 percent for 2023.

According to the trade association's business survey, the participating manufacturers of metallurgical and rolling mill equipment expect sales growth in the low double-digit range (approx. 15 percent) in the current year. Yet, order intake could stagnate at a high level. However, this is against the background of substantial order backlogs.

Comprehensive forum programme around decarbonization and future technologies

During the 'Bright World of Metals' 2023 trade fairs, VDMA Metallurgy, partly together with the Forschungsgemeinschaft Industrieofenbau (FOGI), hosted an extensive program of lectures and discussions. Research, science, and technology suppliers presented solutions for the industrial energy transition. Among others, a moderated sessions focused on the comprehensive decarbonization know-how of metallurgical machinery and plant engineering and the solutions with which the industry is helping to make proven metal production and processing increasingly sustainable.

The VDMA represents more than 3,600 German and European mechanical and plant engineering companies. The industry stands for innovation, export orientation and SMEs. The companies employ around 3 million people in the EU27, more than 1.2 million of them in Germany alone. This makes mechanical and plant engineering the largest employer among the capital goods industries, both in the EU27 and in Germany. In the European Union, it represents a turnover volume of an estimated 860 billion euros. Around 80 percent of the machinery sold in the EU comes from a manufacturing plant in the domestic market.

■ VDMA Metallurgy

Against the backdrop of geopolitical turmoil and high inflation, export growth in the metallurgical plant engineering sectors remained subdued overall in the first quarter of 2023. In detail, however, the industry trends moved in different directions during this period.

Exports of metallurgical plant and rolling mill technology returned to pre-crisis levels, rising by 34 percent between January and March 2023. The top target market in this period was India. In 2022, exports of metallurgical plant and rolling mill technology from Germany had already

25 YEARS OF LIFTING INNOVATION

Combilift celebrates its silver anniversary with five product launches

Combilift, a prominent global manufacturer of multi-directional forklifts and a leader in long load handling solutions, is marking a significant milestone in its journey: 25 years in business



Combilift staff celebrate 25th anniversary at global headquarters (Photo: Combilift)

For 25 years, Combilift has been successfully helping professionals to safely handle long loads and unlock every square metre of their storage space. Together with 120 representatives from trade media from around the world STEEL + TECHNOLOGY was invited to attend the 25th anniversary event at the global headquarters in Ireland in September this year.

A lot has changed since Robert Moffett and Martin McVicar have established Combilift Ltd and launched the world's first engine powered, all wheel drive multi-directional forklift – the Combilift – in 1998. The first C4000 unit was built and sold immediately to the Monaghan bases builder's provider JG Kelly Supplies; it is still in operation today.

Located in the heart of rural Ireland, the global HQ of the company host a team of expert staff that work tirelessly to find

solutions that improve safety, enhance storage and increase the productivity of the users. "Now employing over 800 people in Monaghan and 200 people in other locations across the world, the success of Combilift is testament to our people, our customers and our supporting dealers around the world", says Martin McVicar, Managing Director of Combilift.

Combilift is widely respected for its commitment to the community, both in the business world and in the charitable sector. Earlier this year, the 75,000th unit from Combilift was donated to Convoy of Hope, a non-profit humanitarian and disaster relief organization based in the US but which operates around the world. Speaking at the anniversary event, Minister for Rural and Community Development, Heather Humphreys TD said: "Over the past 25 years, Combilift has made a

very important impact to the Irish economy. Combilift is a visionary company in every sense and I'm delighted that the Irish government, through Enterprise Ireland, has supported Combilift through its incredible 25-year journey."

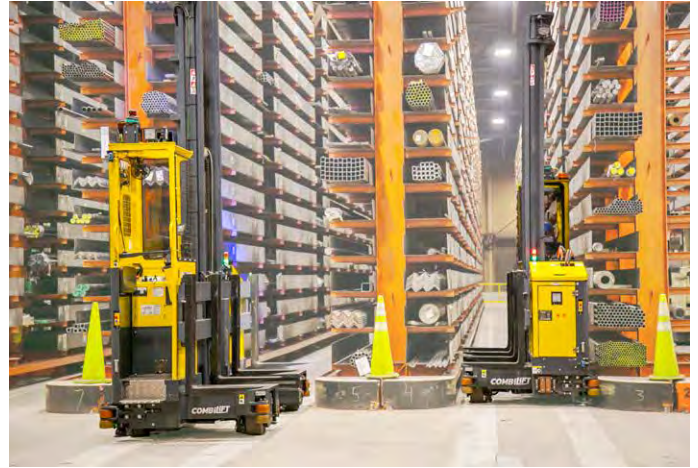
Innovative solutions presented

Martin McVicar said: "We have a track record of innovation at Combilift. We invest 7% of our revenue annually in R&D and today is the culmination of many years' hard work. We are delighted to be continuing this tradition of innovation 25 years on." To commemorate this achievement, the company has unveiled five groundbreaking products that highlight its commitment to innovation and excellence. These new offerings are designed to address the unique challenges faced by various industries, from offshore wind to warehousing and fleet management. The remarkable products launched reaffirm Combilift's position as an industry leader.

Offshore wind handling. One of Combilift's most exciting product launches is the Combi-LC Blade Mover, a testament to the company's expanding horizons. This innovative solution marks Combilift's entry into the offshore wind sector, where it aims to cater to the load handling demands of large-scale offshore wind manufacturers. Developed in collaboration with Siemens Gamesa, the Combi-LC has been meticulously designed to facilitate the seamless movement of wind turbine blades and towers – some as long as 115 m and weighing in at around 70 t, through various production stages and onto storage locations. Its ability to handle oversized products with precision and safety makes it an indispensable asset for offshore wind projects, contributing to greater efficiency and productivity.



Martin McVicar (2nd right) and Heather Humphreys TD with new Combi-CB70E short counterbalance truck (Photo: Combilift)



Combi-AGT is the world's first autonomous dual operational sideloader for long loads (Photo: Combilift)

Autonomous guided forklift excellence.

Another groundbreaking addition to Combilift's portfolio is the Combi-AGT Autonomous Guided Forklift Truck. This 4-wheel electric model is engineered to revolutionise the way long loads are handled in narrow aisles. The Combi-AGT combines advanced autonomous technology with a focus on productivity and safety. This autonomous forklift can operate in guided aisles, ensuring optimal space utilisation, and can also roam freely when necessary. It offers users the flexibility of manual driving (stand on) when required. With its ability to navigate tight spaces efficiently and safely, the Combi-AGT promises to enhance warehouse operations and streamline material handling processes.

Enhanced fleet management. Combi Connect, a telematics software product has been designed to provide customers with invaluable insights into fleet management and usage. Real-time data is a game-changer in the world of logistics and material handling, and Combi Connect delivers exactly that. This telematics solution offers comprehensive information on fleet performance, including location tracking, usage analytics, and maintenance alerts. With this data readily available, businesses can make informed decisions to improve operational efficiency, reduce downtime, and enhance overall performance. Combi Connect represents a significant step forward in fleet management technology, supporting organisations in optimising their material handling processes.

Cutting-edge electric models. The Combi-CUBE represents the pinnacle of electric forklift innovation, boasting a myriad of technological advancements and ergonomic design features. It not only elevates handling procedures but also ensures an unparalleled level of driver comfort. With the optional Dynamic 360 Steering system, this model offers seamless directional changes, setting a new standard for manoeuvrability in the counterbalance forklift market.

The Combi-CB70E, the latest addition to Combilift's ever-expanding electric model lineup. These machines are renowned for their robust performance, extended battery life, and unmatched ergonomic design. The Combi-CB70E is the market's shortest 7-ton capacity counterbalance truck, and its multidirectional capabilities make it the ultimate solution for versatile, space-saving handling of both small and bulky loads.

Conclusion

Combilift's 25th anniversary is not just a celebration of its remarkable journey but also an opportunity to showcase its unwavering commitment to innovation and excellence. The launch of the Combi-LC, Combi-AGT, Combi Connect, Combi CUBE & Combi-CB70E underscores the company's dedication to addressing the unique challenges faced by various industries, from offshore wind to warehousing, climate and logistics. As Combilift continues to push the boundaries of what's possible in material handling solutions, it reaffirms its position as a global leader in the field. These new products represent not only technological advancements but also a promise of greater efficiency, safety, and productivity for its customers around the world. With Combilift at the forefront of innovation, the future of material handling looks brighter than ever.

█ *Combilift*

Milestones in the history of Combilift

- 1998:** World's first engine powered multidirectional forklift
- 1999:** AisleMaster warehouse range introduced
- 2006:** Combilift moves to new premises
- 2010:** Launch of straddle carrier for container handling
- 2014:** Range expands to include the pedestrian trucks
- 2018:** Combilift opens new purpose-built manufacturing facility
- 2023:** 75,000th truck rolls off assembly line in March 2023. Expect to manufacture 10,000 units during the year – reaching 80,000 operating units in 85 countries in total

CUT-TO-SIZE PRODUCTS

Ordered today, delivered tomorrow

What does a steel distributor do to supply its customers reliably with bespoke and in-series produced steel and non-ferrous profiles while maintaining the narrowest tolerances? Bieber + Marburg has opted for a new sawing centre from Kasto. Equipped with this sawing centre, the company can significantly minimise its set-up times and respond more flexibly to customer needs.

At the end of the 19th century, Heinrich Bieber was forced to give up his original profession as a shoemaker because his eyesight was no longer sufficient to practise his trade. As a result, he founded a small business that evolved into a successful company, which currently employs 290 people. Today, the Hessian steel specialist owns more than 40 trucks to supply the steel and metal working companies in the entire southern and central Germany with a complete range of steel products. The company's core customer base consists of mechanical engineering, plant construction, metal and steel construction, machining companies and locksmith shops. The family-owned business supplies these companies with bar steel, tubes, structural steel and wide flange beams, flat products, quality and high-grade construction steel, bright steel, stainless steel, non-ferrous metals, flame-cut parts, reinforcing steel and steel mesh. The steel distributor emphasises not only the uniform appearance of its lorries but all machinery and systems should also correlate with the corporate design.

"We store 28,000 tonnes of steel here on 42,000 square metres," says Marcel Finkernagel, who, as Director of Administration and Organisation at Bieber + Marburg, has extensive knowledge of the company's facilities. "However, we have been more than strictly a steel distributor for quite some time," he emphasises, "our strength lies in processing, i.e. sawing, drilling, laser cutting in the 3D area, blasting, bending and flame cutting". Since customer demands, particularly for sawing, have increased tremendously, the steel distributor needed to examine how to expand in this sector ideally and determine what technology should be incorporated. The conclusion was a new sawing centre from Kasto, the sawing technology specialist based in Achern. Thanks to



The robot at the saw loads the pallets automatically; the employees are then only responsible for securing the load (Picture: Kasto)

many years of collaboration, Bieber + Marburg was familiar with Kasto products and expertise. The steel experts quickly contacted Kasto employees and found the advantages quite impressive, especially the speed of the Kasto sawing centre when demonstrated in a simulation. "When we saw the possibilities the system offers, it was clear that it was the optimum solution for our needs." Marcel Finkernagel explains.

Fully automatic and operator-free

The new KASTOcenter vario plus 4 sawing centre offers impressive dimensions with a length of 50 metres, a width of seven metres and a height of nine metres. "We have about 1,500 shelves and space for materials up to seven metres long and 330 millimetres in diameter," Marcel Finkernagel states.

The long goods are stored and retrieved by an operating gantry crane (OGC) that travels above the shelf block at a speed of up to 60 metres per minute. A fully automatic production circular saw from the KASTOvariospeed series and a KASTOtec SC4 band saw with a connected pallet lift with space for eight Euro pallets are connected to the warehouse. At the circular saw, a KASTOsort robot is responsible for container management: Eight pallet spaces on a carousel change automatically; the robot grips and loads the pallets independently. "This can be carried out even on the weekend, operator free, and the corresponding label is already in the bin, eliminating the need for employee intervention during this time," Finkernagel explains.

The employees at Bieber + Marburg value the products from Kasto; they already operate four fully-automatic bandsaws and



Marcel Finkernagel, Director of Administration and Organisation at Bieber + Marburg, is impressed by the KASTO-center varioplus 4 (Picture: Kasto)



The new sawing centre at Bieber + Marburg has about 1,500 shelves and space for materials up to seven metres long and 330 millimetres in diameter (Picture: Kasto)

one UNICOMPACT honeycomb storage system from the family-owned company based in southern Germany. “The last expansion of the high-bay storage system was about six years ago,” explains Marcel Finkernagel. “And two years ago, it was clear that to become more flexible when it comes to cut-products and minimise the set-up times, we would need to invest once again”, he adds.

Increased capacity, reduced set-up time

“We wanted to increase capacities, process material at short notice, and offer customers batch size 1,” Marcel Finkernagel details. A faster material change and less manual effort were required to achieve this. “The KASTOcenter varioplus 4 enabled us to reduce the set-up time from approx. 15 to 20 minutes to less than two minutes - fully automatically and with consistent cut quality,” he explains enthusiastically.

However, the current sawmill with its four band saws still has its rightful place at Bieber + Marburg, which should remain. The employees there cut the parts with larger diameters that are too heavy for the new KASTOcenter. “Once a certain size is exceeded, the previous technology is still

“**We want to process material at short notice and offer customers batch size 1**”

*Marcel Finkernagel,
Director of Administration and Organisation, Bieber + Marburg*

advantageous,” Finkernagel knows, “in such cases, the set-up time saved is not a factor.” The upper limit for the new sawing centre is 330 millimetres for round material. Anything exceeding this limit is processed on the older conventional band saws.

All demands met

The KASTOcenter varioplus 4 has been operating at Bieber + Marburg in Gießen since July 2020 and cuts solid round, square or flat material. After making some adjustments in close collaboration with Kasto, the system has been fully developed since the end of 2020. “We involved the employees at a very early stage. They contributed to the construction and ideal set-up of the sawing centre,” Finkernagel says. “That generated great acceptance from the very beginning.” Very little training was

required since the operators were already familiar with the operating logic of the KASTOlogic software used on the band saws. As a result, the operators can work flexibly on any system. Although the sawing centre operates for the most part fully automatically, minor interventions such as changing the saw blade and securing the load on the pallets are still necessary.

The investment in the KASTOcenter varioplus 4 has undoubtedly paid off for Bieber + Marburg. “There is no comparable product like it that offers similar advantages,” summarises Finkernagel. “We wanted a quick material change, low set-up times and easy access to the entire product range and that’s what we got. Kasto accommodated all our requests and fulfilled our high demands on our systems.”

■ *Kasto Maschinenbau*

KNIFE ASSEMBLY GOES DIGITAL

Software tool for automatic knife set design and assembly for slitting lines

With the help of the new toiⁱⁱ.Cut software the calculation and assembly of knives in steel service centers can be automated. The software solution digitalizes all preparatory and execution steps on slitting lines: from software-based knife calculation and the automated creation of knife assembly plans to digital tool management.

Digital service provider thyssenkrupp Materials IoT is automating the calculation and assembly of knives in steel service centers with the help of its new toiⁱⁱ.Cut software. It is a further module of toiⁱⁱ, the IIoT platform that digitizes and automates production in the steel and metalworking industry.

The high degree of automation on the shop floor leads to more efficient work and helps to sustainably save costs and reduce throughput times. In addition, the use of the solution means that users are significantly lightened in the execution of their everyday activities. This allows them to focus on infrequently occurring cases, such as calculated knives with warnings or error messages.

Cooperation between processing specialists and software developers

The toiⁱⁱ.Cut software was developed in a two-year cooperation with the processing specialist thyssenkrupp Materials Processing Europe. More than 15 years of experience in software product development and extensive industry knowledge from steel service centers have been incorporated into the development. The aim was to find a solution that could be seamlessly integrated into thyssenkrupp Materials Processing Europe's existing IT system – including its own ERP system – in the ongoing digitalization of steel service centers.

With the help of the solution, the processing specialist is now able to meet increasing requirements such as on-time

delivery, even for orders with small batch sizes or a large quantity of knives to be built. Handwritten work and paper-based processes are also to be replaced. "From an operational excellence point of view, with toiⁱⁱ.Cut we have another building block to increase efficiency, process stability and quality at all our sites through digitalization," says Michael Panzer, Head of Operational Excellence at thyssenkrupp Materials Processing Europe.

Numerous features and continuous development

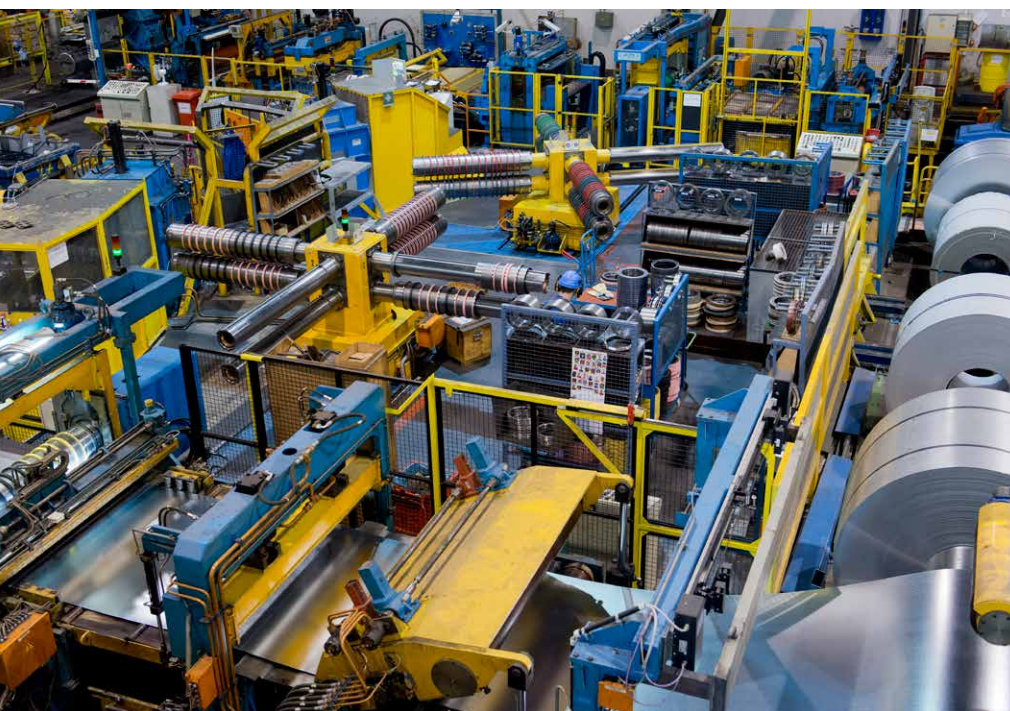
The web-based software solution promises its users a cross-site application with numerous functions and features as well as an intuitive user interface. With the aid of integrated tool management, the use of tools can be optimized and longer knife service lives achieved.

toiⁱⁱ.Cut is continuously optimized and developed further so that users benefit from regular improvements and innovations. Updates can also be made during operation across all machines and locations. "We are in contact with our customers in steel service centers from all over Europe beyond the initial development process and have gained a very good understanding of their requirements. This allows us to ensure that our software remains up-to-date and also meets the individual needs of users," explains Sebastian Lang, Managing Director of thyssenkrupp Materials IoT.

■ *thyssenkrupp Materials Services*

Knife assembly stations at a coil slitting centre of thyssenkrupp Materials Processing Europe

(Picture: thyssenkrupp Materials Services)



GALVANIZED STEEL STRIP

European processors to benefit from strengthened suppliers' partnership

Tata Steel Nederland and Wuppermann Staal Nederland have renewed their supply and tolling agreements. The companies are also launching two strategic initiatives focused on data exchange and scrap metal recycling, making their steelmaking process more sustainable and further strengthening their partnership.

Tata Steel Nederland and Wuppermann Staal Nederland underline their commitment to providing high-quality galvanized hot-rolled strip steel to European customers in a wide range of industries, including automotive and solar energy. "We are excited to take our partnership with Wuppermann to new heights," said Tom Eussen, within Tata Steel Nederland's Board of Management responsible for Tata Steel IJmuiden and the Downstream operations. "Over the past 20 years, Wuppermann has become a key customer and sparring partner for us. This is reflected in our efforts to develop initiatives that are valuable to both of us, such as sharing production data and piloting a scrap metal buy-back programme. These initiatives help us make our steel production process more sustainable today."

"A strong and long-lasting partnership like the one between Tata Steel and Wuppermann is the right basis for implementing such important digitalisation and circularity projects across several stages of the value chain and to realise their full potential", adds Karsten Pronk, Managing Director of Wuppermann Staal Nederland.

Tata Steel and Wuppermann recently signed a new three-year contract for the supply of hot-rolled strip steel with close thickness tolerances and high surface quality, continuing the company's role as the steel processor's primary supplier. Part of the supplied volume will be Zeremis® Carbon Lite – steel with an allocated CO₂ footprint reduction of up to 90%. (This is the maximum reduction for the sum of scope 1, 2 and 3 emissions. For the sum of scope 1 and 2 emissions, this represents a 100% reduction.) Wuppermann and its customers increasingly focus on sustainability within their supply chains. In addition, Tata Steel and Wuppermann have renewed their tolling agreement.



Tata Steel and Wuppermann provide galvanized hot-rolled strip steel in industries such as automotive, solar energy and many others (Picture: Wuppermann AG)

A strong and long-lasting partnership is the right basis for implementing important digitalisation and circularity projects along the value chain and to realise their full potential.

Karsten Pronk, Managing Director of Wuppermann Staal Nederland

The companies are also deepening their collaboration through two strategic initiatives. Tata Steel will share specific production data of the supplied steel, enabling Wuppermann to further optimise steel processing efficiency and reduce waste scrap, thereby achieving cost savings and a more sustainable production process.

Furthermore, the two companies have agreed to pilot operational activities related to a scrap buyback programme, aiming to establish a closed-loop system. This aligns with Tata Steel's commitment to serve its customers ever better and its ambition to

increase the use of scrap in steel production. Recycling each tonne of scrap represents a reduction of 1.6 tonnes of CO₂ compared to steel made from iron ore.

Steel plays a vital role in a wide range of industries, including automotive and solar energy. The use of high-quality steel is important here, for processing and final finishing. Tata Steel supplies such steel to Wuppermann, which galvanises the steel. The processed steel then goes to manufacturers for final processing.

■ Wuppermann AG

THE AMERICAS

Klöckner & Co SE completes acquisition of National Material of Mexico

Klöckner & Co has closed the acquisition of National Material of Mexico (NMM), a leading independent service center and materials supplier serving automotive and industrial end markets in North America with ten subsidiaries throughout Mexico.

The transaction was made through Klöckner & Co's U.S. subsidiary, Kloeckner Metals Corporation. It will enable KMC to significantly expand its footprint in Mexico and increase its presence where the key

automotive and industrial customers are located. Guido Kerkhoff, CEO of Klöckner & Co SE: "The closing of this transaction marks an important milestone on our way to implementing our corporate strategy 'Klöckner & Co 2025: Leveraging Strengths'. As a result, we will further strengthen our position as a leading distributor for steel and metal products and as a steel service company in North America in the long term."

The combined company has a broad presence in all relevant regions in the

USA and Mexico with 56 sites and around 2,600 employees. Going forward, the company aims to expand its market presence, broaden the product offering and further develop existing relationships through cross-selling. The management team of NMM with Carl Grobien and Steve Badya will remain with the company.

■ Klöckner & Co SE

EUROPE

SSAB and Kirchhoff Automotive to collaborate on fossil-free steel

Kirchhoff Automotive has entered into a collaboration with SSAB on the use of the SSAB Fossil-free Steel™ to reduce its CO₂ footprint.

Kirchhoff Automotive, manufacturer of safety-relevant structural components for the international automotive industry, is intensifying its cooperation with SSAB in order to reduce CO₂ in car body construction. By using the SSAB Fossil-free Steel™, the company expects to save almost 40% in emissions in the production of a front bumper, for example.

SSAB Fossil-free Steel™ uses DRI (direct-reduced iron) and is produced with biogas and fossil-free electricity instead of fossil energy.

■ SSAB / Kirchhoff Automotive



Celebrating the collaboration agreement on fossil-free steel
(Photo: Kirchhoff Automotive)

EUROPE

Tibnor plans to adjust cost structure

SSAB's distributor subsidiary Tibnor plans to adjust operations due to lower demand and profitability. The measures cover all Tibnor business areas and countries with the exception of the Baltic countries.

The plan is to implement the measures in the fall of 2023. Tibnor aims to improve the operating efficiency by adjusting the company's cost structure and streamlining the organization. "Demand has slowed down in most countries and in order to ensure our profitability and competitive-

ness in this situation we need to adapt our cost structure," says Fredrik Haglund, President, Tibnor.

■ SSAB / Tibnor

EUROPE

ArcelorMittal and Gestamp sign circularity agreement

ArcelorMittal Europe Flat Products has signed an agreement with Tier 1 automotive supplier Gestamp aimed at strengthening environmental sustainability throughout the industrial supply chain.

The agreement involves jointly designing and implementing a circularity scheme that will enhance the recycling of steel between Gestamp and ArcelorMittal and, ultimately, offer benefits obtained to their automotive customers.

In March 2022, Flat Products delivered its first tonnes of XCarb® recycled and renewably produced substrate, which is made via the electric arc furnace route using a minimum of 75% of scrap steel and 100% renewable electricity for the steel making process. In July 2022, ArcelorMittal and Gestamp successfully trialled the use of low carbon-emissions steel and high scrap content for use in car parts that will ultimately be used in the production of vehicles throughout Europe.

Since December 2022, Gestamp has also provided visibility on its roadmap to promote and extend the business' circular economy model, focusing on the use of recycled steel. Securing the availability of high-quality scrap will support the increased usage of this low-carbon emission steels in automotive parts. The integration of scrap management into Gestamp's business strategy allows for complete life-cycle traceability by integrating the collection, sorting and reuse of quality steel scrap into its production chain, in an environment where this secondary raw material is scarce.

The new agreement signed offers the supply guarantee to the OEMs who want to use reduced CO₂ steel solutions. This collaboration will allow automotive customers, once they have started with the CO₂ performance on their vehicles, to maintain it over the lifespan of the vehicle until end of its production.

| ArcelorMittal

EUROPE

SPM and H2 Green Steel sign supply agreement for green steel

UK-based steel service center SPM (Steel Processing Midlands) has entered into a 5-year supply agreement with H2 Green Steel.

In this contract, SPM secures 25% of its future annual steel demand. "Green steel is undeniably the future. As the cost of emissions start to impact traditionally made steel, green steel will fast become commercially the better option of the two. We choose to embark on this journey early and H₂ Green Steel is the right match for us," says Nick Liggins, Commercial Director, SPM.

H2 Green Steel was launched in 2021. Construction of a modern and fully digitalized steel plant in Northern Sweden has begun. The plant will also include a facility for green hydrogen production from renewable electricity as well as production of green direct reduced iron which will feed the steel mill.

| SPM / H₂ Green Steel

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EUROPE

Ruukki upgrades load-bearing sheet production line

Ruukki Construction, part of the SSAB Group, has upgraded its load-bearing sheet production line in Anderslöv, Sweden, to expand its range of profiles towards stronger products.

Ruukki uses high-quality raw materials to manufacture load-bearing sheets in a range of profile and coating options. Load-bearing profiled sheets are used as a roof or load-bearing structure in, for example, industrial buildings, sports centers, office buildings and renovation projects.

Ruukki Anderslöv specializes in roll-formed metal and has been manufacturing profiles for about 70 years. The factory’s product offering ranges from 20-mm-long electronic parts to 18.5-m-long roof profiles. With the recent upgrade completed, the company is now able to produce stronger T130M load-bearing profiles in addition to the former T130 profiles.



Load-bearing profiled sheet for roof construction and other structural uses
(Photo: Ruukki)

| Ruukki

EUROPE

Low carbon-emissions steel tubes in a joint effort towards decarbonisation

The Van Leeuwen Pipe and Tube Group kickstarts cooperation with ArcelorMittal as part of its efforts to reduce scope 3 emissions

Van Leeuwen Pipe and Tube Group and ArcelorMittal Europe - Tubular Products have announced a new partnership to offer low carbon-emissions steel tubes, enabling companies in construction and engineering industries to reduce the carbon footprint embedded in the products they purchase, as part of their scope 3 emissions. XCarb® recycled and renewably produced steel tubes, produced by ArcelorMittal, and distributed by Van Leeuwen Pipe and Tube Group, can help companies realize CO₂ emissions savings of up to 75 percent compared with conventionally produced steel tubes.

The tubes are manufactured with XCarb® recycled and renewably produced, a label applied to ArcelorMittal’s steel produced in an electric arc furnace (EAF)

using high levels of scrap and 100 percent renewable electricity for the EAF. The electricity used comes from renewable sources such as wind and solar and is supplied via a recognised Guarantee of Origin (GoO) scheme. These steel tubes are the first on the market that enable such a significant reduction in CO₂ emissions, and which come with an Environmental Product Declaration (EPD) to give full data transparency to customers.

The partnership is part of Van Leeuwen’s strategic targets relating to climate action. The company constantly works to identify and reduce its carbon footprint throughout the entire value chain, cooperating with suppliers to produce and distribute pipes and tubes with a reduced carbon footprint.

| ArcelorMittal



First truck delivering low carbon emission steel tubes (Photo: ArcelorMittal)

EUROPE

SSAB and Alfa Laval partner to support global carbon-neutral supply chain

Building on the successful partnership established in 2022, Alfa Laval will now incorporate SSAB's fossil carbon-emission-free and recycled steel, SSAB Zero™, into its heat exchangers.

SSAB Zero™ has zero fossil carbon emissions in operations, including purchased energy and transportation. Only recycled steel is used as a raw material, which means SSAB Zero™ supports the circular economy. SSAB does not engage in carbon emission offsetting activities.

"Alfa Laval's commitment to sustainability is further strengthened through our collaboration with SSAB," says Thomas Møller,

President of the Energy Division at Alfa Laval. "By incorporating their recycled steel in our heat exchangers, we are not only reducing our own carbon footprint, but also driving the entire value chain towards a cleaner and more sustainable future."

In addition to incorporating fossil-free steel in the heat exchanger, Alfa Laval is now also implementing recycled carbon black in the gaskets to reduce CO₂ emissions.

■ *SSAB / Alfa Laval*



EUROPE

Circle Green to help reduce emissions from vehicle manufacturing

Outokumpu, thyssenkrupp Materials Processing Europe and Purem by Eberspaecher continue to strive emission reduction in the automotive industry with Circle Green

Stainless steel producer Outokumpu continues the recent partnership with metals distributor thyssenkrupp Materials Processing Europe. The aim is to reduce emissions from the automotive sector with the world's first towards-zero stainless steel. Purem by Eberspaecher, a specialist in exhaust technology and acoustic solutions, will start using Outokumpu Circle Green supplied by thyssenkrupp Materials Processing Europe, with up to 92% lower carbon footprint than the industry average*. The collaboration is showing the direction of supporting the ambitious EU

level transition towards low-emission mobility.

Within the partnership, the Circle Green material will be supplied to thyssenkrupp Materials Processing Europe by Outokumpu. The service centre experts will be responsible for processing the master coil into slit strips and will manage the just-in-time delivery to Purem by Eberspaecher.

The German supplier works for all automotive manufacturers globally and is part of the Eberspaecher Group. Its reliable solutions include exhaust and thermal management systems as well as automotive controls. The Green Footprint is one of the company's sustainability fields of action with clear goals that include CO₂ neutral production by 2030.

■ *Outokumpu*

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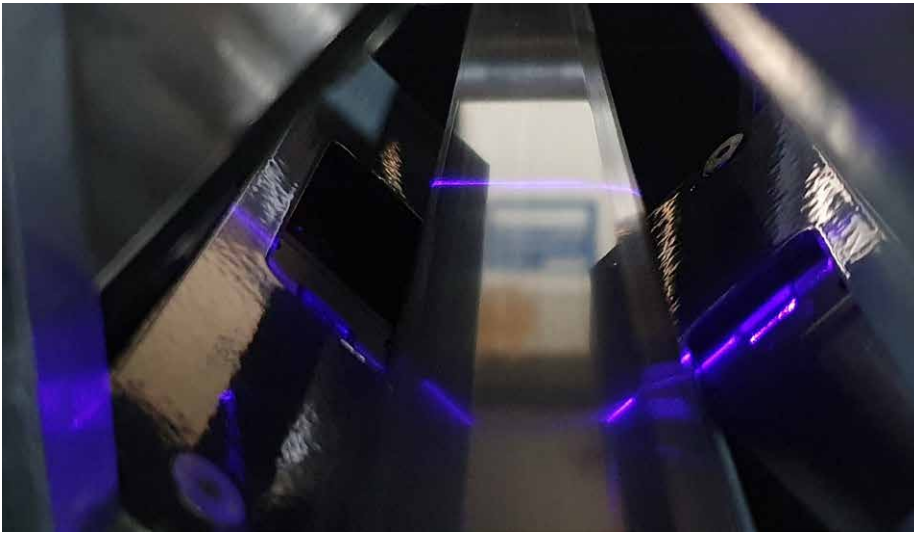
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INNOVATIVE SCANNING SYSTEM

ConScan controls strip edge contours – coil handling to millimetric precision

At blechexpo, hpl-Neugnadenfelder Maschinenfabrik and Genkinger, two companies of the Neuenhauser Group, will exhibit together. "The exhibits show how processes can run 'state of the art'," says Genkinger Managing Director Richard Ludwig.



Productivity leaps through precise real-time measurement of the strip edge contours and corresponding feedback for the line operator

(Picture: hpl-Neugnadenfelder Maschinenfabrik)

At the international trade fair for sheet metal working in Stuttgart, hpl will demonstrate an innovative scanning system for more effectively controlling and correcting strip edge contours of narrow strips (4 to 250 mm width; 0.2 to 3 mm thickness) in the production process. ConScan® shows the user even the smallest deviations from the target strip contour on a monitor and reduces the risk of production downtime.

The measurement results of the hpl system surpass the subjective assessments of the strip edge quality that experienced operators have previously made based on the chip flow. Compared to a microscopic view of a sample piece at the end of the coil, ConScan® has a decisive advantage: It delivers all results not only after an entire coil has been processed, but during operation in real-time.

This is how the ConScan® works: The operator configures a selection of meas-

urement parameters, such as strip thicknesses, chamfer angles/lengths, radii, strip widths etc. He/She then receives the desired information from the system about dreaded cutting burrs or edge chippings. Specified radii and the position of their vertices can now be adhered to more precisely than before. ConScan® can also be retrofitted into existing lines.

From the warehouse to the coiler

Genkinger will present a custom-made electric transporter for handling coils from the warehouse to the coiler. It is designed exactly to the dimensions of the customer's coils: diameters from 970 to 1,500 mm and widths from 340 to 470 mm. For handling these dimensions, a hold-down device is fitted for safety reasons. The maximum load capacity of the coil transporter is 4,500 kg.

The main features of the unit are a wide-track chassis, adjustable prism forks and a hold-down device that can also be adapted to the respective coil. The drive is carried in pendulous bearing, which ensures flexible load distribution, comfortable handling and safe traction at all times.

The "lateral shift" function features a simple, practical two-hand operation to prevent the lifting unit from colliding with the chassis feet when lowered. For cost reasons, this solution was given preference over the alternative electric locking system with wire-rope encoder and circuit extension.

*blechexpo, hall 8, stand No. 8508
Stuttgart, Germany, 7 to 10 Nov 2023*

hpl-Neugnadenfelder Maschinenfabrik



Custom-made electric lift truck for more safety and speed in coil handling

(Picture: Genkinger)

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03 Iron making

03.01 Blast furnaces

1150 Heat recovery systems



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03.02 Direct reduction plants

1160 Direct reduction plants



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04 Steelmaking

1668 Equipment for steelmaking plants



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1670 Engineering and technical assistance



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1698 Steel mill plants and equipment



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04.04 Electric steel plant

1875 Electric arc ladle furnaces



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04.07 Secondary metallurgy

2028 Equipment for chemical heating



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2030 Argon purging equipment

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2080 Ladle metallurgical plants



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2110 Secondary metallurgical plants



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2120 Steel degassing plants



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2130 Steel desulfurization plants



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2140 T+P lance equipment



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04.08 Tertiary metallurgy

2144 Vacuum degassing equipment



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04.09 Components

2150 Deslagging machines



DANGO & DIENENTHAL Group
Hagener Str. 103
57072 Siegen, Germany
☎ +49 271 401-0
E-Mail: contact@dango-dienenthal.de
Internet: www.dango-dienenthal.de

2175 Burning machines for ladles



WEEBOTEC GmbH
Lingenstr. 12-14
45472 Mülheim an der Ruhr, Germany
☎ +49 208 49538-700
☎ +49 208 49538-799
E-Mail: info@weebotec.de
Internet: www.weebotec.de

2180 Break-out machines for electric furnaces, converters, ladles, etc.



DANGO & DIENENTHAL Group
Hagener Str. 103
57072 Siegen, Germany
☎ +49 271 401-0
E-Mail: contact@dango-dienenthal.de
Internet: www.dango-dienenthal.de

2182 Burning lances (oxygen) for tundish and ladle gate valves

BEDA-Oxygentechnik GmbH
An der Pönt 59
40885 Ratingen, Germany
☎ +49 2102 9109-0
E-Mail: info@BEDA-com
Internet: www.BEDA.com

2230 Charging machines (trough and tongs)



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☎ +49 271 401-0
E-Mail: contact@dango-dienenthal.de
Internet: www.dango-dienenthal.de

2270 Injection plants for argon

BEDA-Oxygentechnik GmbH
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40885 Ratingen, Germany
☎ +49 2102 9109-0
E-Mail: info@BEDA-com
Internet: www.BEDA.com

2440 Handling equipment for oxygen/carbon lances

BEDA-Oxygentechnik GmbH
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☎ +49 2102 9109-0
E-Mail: info@BEDA-com
Internet: www.BEDA.com

2490 Coal dust injection lances

BEDA-Oxygentechnik GmbH
An der Pönt 59
40885 Ratingen, Germany
☎ +49 2102 9109-0
E-Mail: info@BEDA-com
Internet: www.BEDA.com

2530 Lance robots/-manipulators

BEDA-Oxygentechnik GmbH
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40885 Ratingen, Germany
☎ +49 2102 9109-0
E-Mail: info@BEDA-com
Internet: www.BEDA.com

2580 Oxygen nozzles



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 Internet: www.loi.tenova.com

2600 Oxygen lance equipment

BEDA-Oxygentechnik GmbH
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 40885 Ratingen, Germany
 ☎ +49 2102 9109-0
 E-Mail: info@BEDA-com
 Internet: www.BEDA.com

2655 Fuses (multifunction) for burners

BEDA-Oxygentechnik GmbH
 An der Pönt 59
 40885 Ratingen, Germany
 ☎ +49 2102 9109-0
 E-Mail: info@BEDA-com
 Internet: www.BEDA.com

2660 Special safety oxygen hose reels

BEDA-Oxygentechnik GmbH
 An der Pönt 59
 40885 Ratingen, Germany
 ☎ +49 2102 9109-0
 E-Mail: info@BEDA-com
 Internet: www.BEDA.com

04.10 Steel works materials

2735 EBT taphole plugging compound



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 45472 Mülheim an der Ruhr, Germany
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 ☎ +49 208 49538-799
 E-Mail: info@weebotec.de
 Internet: www.weebotec.de

2880 Ladle slide sand



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 ☎ +49 208 49538-700
 ☎ +49 208 49538-799
 E-Mail: info@weebotec.de
 Internet: www.weebotec.de

07 Hot rolling

07.10 Components

4430 Decoilers and rewinders



GUILD International
 7273 Division Street
 Bedford, OH 44146, USA
 ☎ +1 440-232-5887
 E-Mail: sales@guildint.com

08 Forging, extrusion

08.03 Components

5150 Forging manipulators



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 ☎ +49 271 401-0
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 Internet: www.dango-dienenthal.de



Glama Maschinenbau GmbH
 Hornstr. 19
 45964 Gladbeck, Germany
 ☎ +49 2043 9738-0
 ☎ +49 2043 47268
 Internet: www.glama.de

5155 Forging manipulators, rail-mounted



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 E-Mail: contact@dango-dienenthal.de
 Internet: www.dango-dienenthal.de



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 ☎ +49 2043 47268
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5160 Forging robots



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 ☎ +49 2043 47268
 Internet: www.glama.de

5180 Transport manipulators



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 Internet: www.dango-dienenthal.de

10 Cold rolling

10.01 Cold rolling mills

5490 Strip, sheet, cold and metal rolling mills



hpl-Neugnadenfelder Maschinenfabrik GmbH
 Spangenbergstr. 20
 49824 Ringe/Neugnadenfeld, Germany
 ☎ +49 5944 9301-0
 E-Mail: info@hpl-group.de
 Internet: www.hpl-group.de

10.04 Annealing lines

5670 Annealing lines



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11 Surface treatment

11.04 Surface treatment plants

6270 Strip edge trimming



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 49824 Ringe/Neugnadenfeld, Germany
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 E-Mail: info@hpl-group.de
 Internet: www.hpl-group.de

6280 Strip processing and finishing lines



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 49824 Ringe/Neugnadenfeld, Germany
 ☎ +49 5944 9301-0
 E-Mail: info@hpl-group.de
 Internet: www.hpl-group.de

11.05 Aluminizing, tin plating, galvanizing

6630 Hot dip galvanizing lines



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13 Production of tubes/pipes

13.04 Finishing lines for tubes

7520 Tube bending machines



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7544 Tube straightening machines



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 Internet: www.dango-dienenthal.de

14 Sheet metal processing

14.03 Welding technology

8120 Strip welding machines



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 Bedford, OH 44146, USA
 ☎ +1 440-232-5887
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8205 Laser welding machines



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8210 Laser beam welding machines



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8220 MIG, MAG and TIG\057TIG welding torches



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8257 Rolling seam resistance welding equipment



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8330 Welding machines, general



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8360 Welding accessories, general



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8380 Butt welding machines, electric



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8400 Resistance welding equipment



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16 Furnace and energy technology

10170 Furnace optimization (conversion to low NOx combustion)



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10190 Rational use of energy



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16.02 Forging furnaces

10230 Forging furnaces



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16.03 Roller Hearth Continuous Furnaces

10260 Roller Hearth Continuous Furnaces



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10270 Roller hearth and walking beam furnaces



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16.05 Top-hat furnaces

10310 Top-hat furnaces



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16.08 Heating furnaces and heat treatment plants

10408 Continuous furnaces



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10410 Co-step furnaces



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10430 Bogie hearth furnaces



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10460 Chamber furnaces



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10510 Roller hearth and walking beam furnaces



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10540 Pusher-type, roller and rotary hearth furnaces



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10560 Heat treatment plants



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10562 Heat treatment furnaces (continuous and discontinuous)



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10570 Heat treatment furnaces for batch operation, open heated



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16.09 Bath furnaces

10580 Aluminum melting furnaces



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16.13 Components

10890 Natural gas burners



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11010 Regenerative burners



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 Internet: www.flox.com

11020 Recuperative burners



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 Internet: www.flox.com

11070 Radiant tube burners



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18 Machinery and plant engineering

12210 Plant engineering, general



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18.06 Ventilation plants and equipment

12660 Air conditioners for heat plants



FrigorTec GmbH
 Hummelau 1
 88279 Amtzell, Germany
 ☎ +49 7520 914820
 E-Mail: info@frigortec.com
 Internet: www.frigortec.com

12670 Air conditioners for crane lances, crane bridges, etc.



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 88279 Amtzell, Germany
 ☎ +49 7520 914820
 E-Mail: info@frigortec.com
 Internet: www.frigortec.com

18.10 Power and work machines

13070 Piston pumps



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 ☎ +41 52 625 62 11
 E-Mail: info@hydrowatt.com
 Internet: www.hydrowatt.com

13160 Vacuum pumps



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21 Measuring and testing technique

21.01 Measuring and testing technology, general

16510 Measurement technology



PROMECON process measurement control GmbH
 Steinfeldstr. 5
 39179 Barleben, Germany
 ☎ +49 39203 512-0
 ☎ +49 39203 512-202
 E-Mail: info@promecon.com
 Internet: www.promecon.com

16520 Measuring and testing systems, general



PROMECON process measurement control GmbH
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 39179 Barleben, Germany
 ☎ +49 39203 512-0
 ☎ +49 39203 512-202
 E-Mail: info@promecon.com
 Internet: www.promecon.com

21.02 Measurement of physical properties

16830 Speed measuring devices



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 76337 Waldbronn, Germany
 ☎ +49 7243 604-0
 ☎ +49 7243 69944
 E-Mail: info@polytec.de
 Internet: www.polytec.de

16910 Length measuring devices for tubes



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 ☎ +49 7243 69944
 E-Mail: info@polytec.de
 Internet: www.polytec.de

16960 Laser speed and length measuring systems



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 ☎ +49 7243 69944
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 Internet: www.polytec.de

24 Environmental protection and disposal

24.01 Dedusting and gas cleaning

18360 Exhaust gas cooling systems



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18400 Treatment of dusts from steel mills and foundries



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 ☎ +49 6283 51-325
 E-Mail: eirich@eirich.de
 Internet: www.eirich.de

List of Products

01 Raw materials, auxiliary materials and operating materials

01.01. Ores

- 10 Chrome ore
- 20 Iron ores
- 30 Ores
- 40 Manganese ore
- 50 Steel mill ores

01.02. Coal, coke

- 60 Lignite coke
- 62 Injection coal
- 65 Foundry coke
- 67 Coal / coke conveyor
- 70 Coke
- 80 Coke breeze
- 90 Coke breeze, dry
- 100 Petroleum coke
- 110 Hard coal, anthracite

01.03. Scrap

- 120 Scrap metal

01.04. Sponge iron

- 128 Sponge iron
- 130 Sponge iron

01.05. Metals and alloys

- 140 Cermix metal
- 150 Chromium metal
- 160 Cobalt
- 170 Deoxidation alloys
- 180 Iron granules
- 190 Iron powder
- 200 Ferrobob
- 210 Ferrochrome
- 220 Ferromanganese
- 230 Ferromolybdenum
- 240 Ferronickel
- 250 Ferroniobium
- 260 Ferro-niobium carbide
- 270 Ferroniob powder
- 280 Ferrophosphorus
- 290 Ferro-selenium
- 300 Ferrosilicon
- 310 Ferro-silicon-magnesium
- 315 Ferro-silicon-manganese
- 320 Ferrotitanium
- 330 Ferrovanadium
- 340 Ferrotungsten
- 350 Ferrozinc
- 380 Alloys
- 385 Magnesium alloys
- 390 Manganese metal
- 400 Metals and alloys
- 410 Metal powder
- 420 Molybdenum
- 430 Molybdenum oxide
- 435 Non-ferrous metals
- 440 Nickel

- 450 Nickel-based alloys
- 460 Nickel niobium
- 470 Niobium, metals and alloys
- 475 Pure iron
- 480 Silicon carbide
- 490 Silicon and silicon alloys
- 500 Special metals
- 510 Special alloys
- 520 Tantalum
- 530 Titanium and titanium alloys
- 540 Vanadium metal
- 550 Vanadium pentoxide
- 560 Master alloys
- 570 Tungsten
- 572 Tungsten granules for C and S analysis
- 610 Alloying additions

01.06. Additives and fluxes

- 580 Carburizing agent
- 590 Fluorspar
- 600 Lime and limestone
- 612 Slag conditioner
- 616 Olivine
- 618 Raw bauxite

01.07. Gases

- 620 Acetylene
- 625 Argon
- 630 Gases, technical
- 640 Carbonic acid
- 650 Oxygen
- 660 Protective gas
- 670 Nitrogen
- 675 Hydrogen

01.08. Lubricants

- 680 Coating powder
- 690 Lubricants

01.09. Composite materials

- 678 Bimetal for saws

01.10. Water

- 691 River water / additional water

01.11. Other

- 695 Glass granules
- 698 Titanium dioxide for hearth protection / repair

02 Raw material pretreatment

- 700 Engineering and technical assistance
- 703 Engineering and project management

02.01. Ore dressing

- 710 Ore and aggregate processing plants
- 720 Crushing plants
- 730 Grinding and mixing plants
- 740 Mixers / core sand mixers

- 750 Screens
- 760 Screens and screening plants

02.02. Coal preparation

- 770 Coal preparation plants
- 780 Coal grinding plants

02.03. Coal burden preparation

- 790 Coal burden preparation

02.04. Pelletizing plants

- 795 Ore preparation plants
- 797 Conveying plants for pellets
- 800 Pelletizing plants
- 810 Pelletizing plants with ore preparation plants

02.05. Sintering plants

- 820 Sintering plants
- 822 Sinter hot material conveyors
- 826 Grate bars for sinter plants

02.06. Briquetting plants

- 830 Briquetting plants
- 840 Briquetting of coal and coke
- 850 Compacting plants

02.07. Coke plants

- 858 Emission control in coking plants, charging and discharging
- 859 Heat-recovery coking plants
- 860 Coke plants, general
- 870 Coke crushing and screening plants
- 890 Coke ovens
- 900 Coke oven operating machines
- 910 Coke oven gas treatment plants
- 920 Coke ramming and extruding machines
- 950 Heat exchangers

02.08. Scrap processing plants

- 968 Coil magnets
- 970 Lifting magnets
- 980 Magnetic drums
- 990 Packing presses
- 999 Scrap drying plants
- 1000 Scrap mills, lick-ers
- 1010 Scrap shears
- 1015 Scrap shear blades
- 1017 Scrap magnets
- 1020 Shredder plants
- 1021 Safety equipment for electric load lifting magnets
- 1022 Separation magnets
- 1030 Chip crusher

02.09. Other equipment

- 1041 Equipment for granulation of sludges and dusts
- 1050 Ferroalloying plants
- 1058 Lime burning plants
- 1060 Lime slaking plants
- 1070 Roasting plants

03 Iron making

- 1080 Engineering and technical assistance
- 1090 Pig iron production plants
- 1100 Smelter reduction plants

03.01. Blast furnaces

- 1105 Energy recovery
- 1107 Expansion turbine
- 1110 Blast furnaces
- 1120 Blast furnace linings
- 1123 Blast furnace hearth protection/repair
- 1125 Blast furnace channel lining
- 1130 Blast furnace hot blast stoves
- 1140 Ceramic burners for hot blast stoves
- 1145 Shaft melting furnaces
- 1150 Heat recovery systems
- 1152 Hot blast stoves

03.02. Direct reduction plants

- 1160 Direct reduction plants
- 1170 Direct reduction plants with coal as reducing agent
- 1172 DRI hot material conveyor
- 1174 Fine ore reduction with coal or gas

03.03. Cupola furnaces

- 1180 Hot blast cupola furnaces
- 1190 Cold blast cupola furnaces
- 1195 Shaft furnaces for metallurgical residues

03.04. Components

- 1200 Valves for blast furnace reheaters
- 1205 Fittings for cupola furnaces
- 1207 Copper fittings for cupolas
- 1210 Slide gate maintenance
- 1220 Gassing systems for blast furnaces, cupolas and steel mills
- 1230 Blow mold changing and nozzle block removal carriages
- 1240 boring bar changing devices
- 1250 Nozzle bars
- 1260 Injection plants for carbon
- 1270 Equipment for injecting coal, oil or gas into the blast furnace
- 1280 Equipment for injecting oil or gas into the blast furnace
- 1285 Blast furnace gas expansion turbines
- 1290 Hood manipulators for use on iron channels
- 1295 Hot gas generators for blast furnace and coke gas
- 1300 Hot blast valves
- 1310 Blast furnace blowers
- 1320 Blast furnace stands and shells
- 1330 Blast furnace burdening / also burdening carriages
- 1340 Blast furnace probes
- 1350 Coal grinding, drying and injection systems
- 1351 Copper fittings for cupola furnaces
- 1353 Ladles and mixers, liquid pig iron, engineering and supply
- 1355 Process gas screw compressors
- 1360 Radar level measuring equipment

- 1370 Rest and shaft cooling plates for blast furnaces
- 1380 Pig iron bulk pouring machines
- 1390 Pig iron mixers
- 1400 Pig iron ladle, mixer and transfer cars
- 1410 Slag molds
- 1420 Slag ladles
- 1425 Hoses for blast furnace cooling
- 1430 Special fittings for blast furnace cooling
- 1432 Copper staves for blast furnace cooling
- 1440 Taphole tamping machines
- 1450 Tap hole and slag hole drilling machines
- 1458 Distributor systems for charging burden /ore/ coke into the blast furnace
- 1460 Heat exchangers
- 1467 Weighing systems for torpedo cars
- 1470 Wind molds and nozzle stacks
- 1480 Wind vane

03.05. Blast furnace products for foundries

- 1490 Foundry pig iron
- 1500 Hematite pig iron
- 1510 Hematite pig iron for GG
- 1520 Blast furnace ferro-manganese
- 1550 Special pig iron for GGG
- 1560 Mirror Iron
- 1570 Steel iron

03.06. By-products

- 1580 Ferrous sulfate
- 1589 Blast furnace slag
- 1590 Blast furnace slag as a road construction material
- 1600 Blast furnace slag and LD slag
- 1620 Slag lime
- 1630 Slag Sand
- 1639 Converter lime
- 1640 Converter lime057 Thomas lime
- 1643 LD slag
- 1650 Thomas phosphate

04 Steelmaking

- 1668 Equipment for steelmaking plants
- 1670 Engineering and technical assistance
- 1680 Compact steelmaking equipment
- 1690 Second-hand steelmaking plant and equipment
- 1698 Steel mill plants and equipment
- 1699 Steel mill equipment
- 1700 Steel mill plants and equipment (stainless)
- 1710 Steel mill plants and equipment (complete)

04.01. Hot metal preparation plants

- 1715 Desulfurization plants with slag regeneration
- 1720 Hot metal desulfurization plants

04.02. Converter

- 1730 Blown steelmaking plants
- 1740 KTB (Kawasaki Top Blowing) equipment
- 1745 Combined bottom blowing at converter
- 1750 Converter plants

- 1755 Converter sealing plugs
- 1758 Setting machines for converter sealing plugs
- 1760 Purging stones

04.03. Energy optimization furnaces

- 1770 Energy optimization furnaces

04.04. Electric steel plant

- 1780 Charging equipment for electric furnaces
- 1788 Bottom blowing equipment for electric arc furnaces (nitrogen and argon)
- 1790 Bottom tapping
- 1795 CO post-combustion
- 1800 Three-phase arc furnaces
- 1810 Injection systems for electric furnaces
- 1820 Electrode holders and contact jaws for electric furnaces
- 1830 Electrode control for electric arc furnaces and ladle heating systems
- 1840 Electrode extruders
- 1850 Electrode support arms
- 1855 Aluminum electrode support arms, current-carrying (Hot Arms)
- 1860 Electrode support arms, current-carrying (Hot Arms)
- 1865 Electrode discharge arm insulation
- 1870 Electric arc furnaces
- 1875 Electric arc ladle furnaces
- 1880 Electric arc furnaces with integrated scrap preheating (shaft furnaces)
- 1885 Spare and wear parts, consumables
- 1890 Direct current arc furnaces
- 1900 Graphite electrodes
- 1908 Jet Box Technology
- 1910 Cooling elements (tube wall segments, bay covers, plate coolers)
- 1920 Oil / 057gas oxygen burners (also post-combustion)
- 1930 Scrap baskets
- 1938 Scrap dryers
- 1940 Scrap preheating systems
- 1945 Poking machines for electric furnaces
- 1950 Electric tube systems for electric furnaces
- 1960 Water cooled cables
- 1970 Water cooling systems
- 1980 AC arc furnaces
- 1981 EAF high current insulation
- 1982 Power supplies for AC arc furnaces
- 1983 Power supplies for direct current arc furnaces

04.05. Induction furnaces

- 1990 Induction furnaces
- 1995 Protection system for induction coils
- 1996 Induction furnaces \ 057Repairs
- 2000 Water cooled cables

04.06. Vacuum furnaces

- 2008 High vacuum furnaces
- 2010 High vacuum furnaces (also electron beam melting furnaces)
- 2020 Vacuum induction melting furnaces
- 2021 Vacuum pumps, dry running, for vacuum furnaces
- 2025 Vacuum investment casting plants

04.07. Secondary metallurgy

- 2028 Equipment for chemical heating
- 2030 Argon purging equipment
- 2040 Blow and injection conveying systems for filter dusts
- 2042 blowing lances, combined, for RH
- 2050 CAS, CAS-OB and CAB-plants
- 2060 Injection plants for metallurgical processes
- 2070 Electroslag remelting plants
- 2080 Ladle metallurgical plants
- 2090 Plasma arc plants
- 2100 Plasma ladle furnaces
- 2110 Secondary metallurgical plants
- 2120 Steel degassing plants
- 2130 Steel desulfurization plants
- 2140 T+P lance equipment
- 2145 Induction stirrers for ladle furnaces
- 2147 Vacuum degassing plants
- 2148 Vacuum arc furnace

04.08. Tertiary metallurgy

- 2141 Electroslag remelting plant ESU plant
- 2142 Vacuum arc remelting /VAR plant
- 2143 Vacuum induction furnace /VIM plant
- 2144 Vacuum degassing equipment

04.09. Components

- 2150 Deslagging machines
- 2155 Tap hole sealing equipment for converters
- 2156 Converter tap hole drilling and setting machines
- 2160 Tapping gate for converters and electric arc furnaces
- 2170 Andromat manipulator
- 2175 Burning machines for ladles
- 2180 Break-out machines for electric furnaces, converters, ladles, etc.
- 2182 Burning lances (oxygen) for tundish and ladle gate valves
- 2184 CO injection equipment
- 2190 Handling equipment for oxygen /carbon lances
- 2200 Automatic purging gas dome stations
- 2210 Heating equipment for ladles, mixers, converters and tundishes
- 2215 Feeding equipment for metallurgical plants
- 2220 Brakes
- 2230 Charging machines (trough and tongs)
- 2235 Steam jet vacuum pumps for steel degassing
- 2240 Dolomite centrifugal machines
- 2250 Wire spooling machines
- 2268 Injection plants for argon in ladles
- 2270 Injection plants for argon
- 2280 Injection plants for iron carbide dusts
- 2290 Injection plants for Hy /DRI dusts
- 2300 Injection plants for lime granules
- 2310 Injection plants for carbon (electric arc furnaces)
- 2312 Injection plants for alloying materials
- 2320 Electric heating elements for steel degassing plants
- 2340 Electromagnet. Conveying and dosing troughs for liquid metals
- 2350 Desulfurization equipment
- 2360 Oriol tapping fillers, electric arc furnaces
- 2370 Casting ladles, general

- 2380 Casting ladle heaters
- 2390 Ladles for steel mills
- 2400 Casting ladle gates (also slide gate gates)
- 2410 Pouring stream protection
- 2420 Casting carriages
- 2430 Handling equipment
- 2440 Handling equipment for oxygen / carbon lances
- 2450 Metallurgical and rolling mill hydraulics
- 2460 Lime-oxygen dosing and injection systems
- 2480 Tilting chairs for ladles
- 2490 Coal dust injection lances
- 2500 Ingot molds and casting molds for steel mills
- 2510 Ingot mold cars
- 2514 Continuous optical analysis equipment for process vessels
- 2515 Continuous optical temperature measurement for process vessels
- 2520 Converter blowing lance changing device
- 2525 Converter temperature and sampling equipment
- 2530 Lance robots \ 057-manipulators
- 2540 Alloying equipment for steel mills
- 2541 Multifunction lances and burners for electric furnaces
- 2542 Ladles and mixers, liquid pig iron, engineering and supply
- 2543 Mixer ladles
- 2545 Ladle sliders (steel mill ladle slider material)
- 2550 Ladle cars
- 2560 Robots for cutting slag
- 2570 Sand feeding devices for ladle tap hole
- 2580 Oxygen nozzles
- 2590 Oxygen lances
- 2600 Oxygen lance equipment
- 2610 Oxygen tubes, heat protected
- 2615 Shadow tube manipulators
- 2618 Slag with space resistant property
- 2620 Slag bucket
- 2630 Slag retaining device for converter
- 2640 Slag carts
- 2650 Hose reels
- 2655 Fuses (multifunction) for burners
- 2660 Special safety oxygen hose reels
- 2665 Stone coating agent for ladle gate valves
- 2666 Stone coating agents for slide gate systems
- 2668 Poking machines for electric furnaces
- 2669 Sublances
- 2670 Immersion tube spraying devices
- 2680 Torpedo car radar level measuring devices
- 2686 Vacuum pumps, dry running, for vacuum furnaces
- 2690 Preheating and drying stations for ladles and tundishes
- 2695 Weighing systems for scrap and alloying elements
- 2700 Heat exchangers for steel mills
- 2702 Flame cutting machines for ladles
- 2704 Crucibles for remelting furnaces
- 2705 Process gas analyzer

04.10. Steel mill supplies

- 2706 Sealing cords and packings up to 1260 °C
- 2710 Carburizing agents of all kinds

- 2720 Deoxidizing agent
- 2730 Deoxidation technology
- 2735 EBT taphole plugging compound
- 2740 Dephosphorizing agents
- 2750 Desulfurization and deoxidation agents
- 2760 desulfurization agents (also magnesium)
- 2770 ESU slags
- 2780 Ferroniob cored wires
- 2790 Cored wires
- 2798 Casting heads
- 2800 Casting powder
- 2801 Casting powders, granulated and powdered
- 2810 Graphite
- 2820 Graphite powder
- 2825 Heat protection fabric to 1260 °C
- 2827 Insulating covering agents for tundishes, ladles and troughs
- 2830 Molds
- 2840 Mould inserts
- 2845 Chill putty, -filler up to 1600 °C
- 2850 Ingot mold spray and plate protection
- 2855 Oxygen nozzles and blowing lances
- 2860 Blowhole powder
- 2865 Mats and felts up to 1260 °C
- 2868 Olivine slag conditioner
- 2870 Ladle covering agent
- 2871 Ladle covering agents, granulated and powdered
- 2880 Ladle slide sand
- 2885 Rotary slide gate for steel ladles
- 2888 Slag granulation
- 2890 Slag sands
- 2900 Slag foaming
- 2904 Protective blankets made of textile fabric up to 1260 °C
- 2905 Special adhesives up to 1200 °C
- 2910 Steel mill ladle slide material
- 2915 Crucibles for ESR, VAR and casting rolls
- 2920 Tundish covering material, granulated and powdered

04.11. Preparation of steel mill materials

- 2930 Processing of used refractory materials
- 2940 Processing of steel mill dusts, fines and oil-containing steel mill sludges
- 2950 Slag preparation (slag transport and recycling)
- 2954 Separation magnets

04.12. Services

- 2956 Engineering for steel mill plants and equipment
- 2957 Hydraulic cylinder repair
- 2958 Slag bucket maintenance

05 Continuous casting

- 2960 Engineering and technical assistance

05.01. Continuous casting plants of various designs

- 2962 Flat ingots
- 2965 Casting platform robot
- 2970 Casting wheel plants
- 2980 Casting wheels

- 2982 Casting rolls, rollers
- 2990 Horizontal continuous casting plants
- 3000 Continuous casting plants, general
- 3010 Vertical continuous casting plants

05.02. Continuous casting plants for different product dimensions

- 3020 Beam-blank continuous casters
- 3030 Continuous slab casters
- 3035 High-speed continuous billet casters
- 3040 Continuous billet casters
- 3043 Continuous billet casters, horizontal
- 3045 Combined continuous slab casters
- 3050 Round continuous casters
- 3055 Round continuous casting machines, horizontal
- 3058 Continuous bloom casting plants
- 3060 Continuous bloom and slab casters
- 3070 Continuous bloom and billet casting plants
- 3075 Continuous bloom and billet casting plants, horizontal
- 3080 bloom and round continuous casting plants
- 3085 bloom and billet continuous casting plants, horizontal

05.03. Spray compacting plants

- 3090 Spray compacting plants

05.04. Components

- 3100 Al wire injection plants
- 3110 Slab edge adjustment
- 3120 Slab edge heating, inductive
- 3130 Slab cooling plants
- 3140 Slab cooling boiler/heat recovery plants
- 3150 Slab cross-cutting and slitting lines
- 3160 Slab grinding machines
- 3166 Soft slab turning and transporting magnets
- 3170 Brakes
- 3180 Flame removal equipment
- 3190 Flame cutting equipment
- 3200 Slewing ring for water cooled rolls
- 3210 DS stamping machine
- 3216 Electromagnetic brakes, EMBR
- 3220 Single material nozzles for continuous casting cooling
- 3230 Deburrer
- 3240 Inks for marking equipment
- 3250 Paint signing equipment
- 3260 Casting powder feeder
- 3262 Casting stream protection by argon
- 3270 Inductive stirring
- 3280 Cold distribution plates (tundish plates)
- 3290 Marking equipment for slabs, ingots and billets
- 3292 Billet grinding machines
- 3300 Billet processing machines
- 3310 Billet sawing machines
- 3320 Billet grinding machines
- 3330 Mould flow measuring equipment
- 3340 Reading systems for automatic identification of impact and directly applied marks
- 3345 Air atomization nozzles for continuous casting cooling

- 3346 Marking machines
- 3350 Emergency cutting torches
- 3355 Optical product recognition (OPR) for marked billets
- 3360 Plasma tundish heating
- 3370 Plate molds
- 3380 Precision stopper device
- 3390 Tube molds
- 3400 Shadow tube manipulators
- 3405 Safety device for electrolift magnets
- 3410 Marking colors
- 3415 Slab magnets
- 3420 Stamping machines
- 3422 Stamping machines, hydraulic or pneumatic drive
- 3429 Continuous casting molds
- 3430 Continuous casting molds (also made of electrographite)
- 3440 Continuous casting rolls
- 3450 Tundish heating
- 3460 Tundish (manifold) plasma heater
- 3470 Tundish flow control
- 3480 Tundish gate valve (Tundish gate valve) bloom and billet adjustments
- 3490 Heat exchangers
- 3500 Weighing systems for ladles, tundish etc.
- 3510 Two-substance nozzles for continuous casting cooling

05.05. Operating materials

- 3520 Casting powder
- 3530 Lubricants for continuous casting plants
- 3535 Welding consumables for regeneration and against wear

05.06. Services

- 3537 Grinding and scarfing of slabs, billets and blooms

06 Near net shape casting

- 3540 Engineering and technical assistance

06.01. Equipment

- 3550 Strip casting lines
- 3560 Thin strip casting plants
- 3570 Thin slab casting plants
- 3572 Thin slab casting and rolling lines with direct bond
- 3573 EUROSTRIP strip casting plants
- 3574 EUROSTRIP direct strip casting and rolling lines
- 3575 Continuous billet casting plants

06.02. Components

- 3590 Flame cutting equipment
- 3600 Flame cutting equipment
- 3610 DS stamping machine
- 3630 Thin slab cross and slitting lines
- 3640 Thin slab grinding machines
- 3670 Color marking equipment
- 3680 Casting powder feeder
- 3690 Ingot molds

- 3700 Reading systems for automatic identification of impact and directly applied characters
- 3710 Marking inks
- 3712 Stamping machines, hydraulic or pneumatic drive

06.03. Operating supplies

- 3750 Coolant
- 3760 Lubricants

07 Hot rolling

- 3770 Engineering and technical assistance
- 3780 Second-hand hot rolling mills

07.01. Hot strip mills

- 3773 Flat block plants
- 3776 Flat block plants for rolling
- 3790 Thin slab mills
- 3805 Modernization of hot rolling mills
- 3820 Steckel rolling mills, complete
- 3830 Rolling mills, complete
- 3840 Hot rolling mills for slab products

07.02. Heavy plate mills

- 3850 Hot rolling mills, complete

07.03. Billet and semi-finished product mills

- 3860 Ingot, billet and plate mills
- 3861 Ingot, billet and semi-finished product mills

07.04. Section mills

- 3870 Rolling mills for light sectional steel
- 3875 Roll forming mills
- 3880 Special section rolling mills
- 3881 Rail rolling mills
- 3890 Beam and other section mills

07.05. Bar and wire rod mills

- 3900 Automatic coil handling
- 3910 Guide equipment for wire rod, bar and fine iron mills
- 3920 Calibrating mills
- 3930 Precision rolling systems
- 3940 Reducing and sizing mills
- 3944 Reducing and sizing mills
- 3950 Bar and wire rod mills
- 3955 Bar and wire rod mills for carbon and stainless steels
- 3960 Bar mills
- 3968 Rolling mills for flat products
- 3970 Rolling mills for long products
- 3974 Rolling mills for wire rod, rebars and bars

07.06. Ring rolling mills

- 3980 Ring rolling machines and plants
- 3981 Wheel rolling machines and plants

07.07. Finishing lines

- 3990 Finishing lines
- 4000 Finishing machines

- 4010 Chamfering machines for round and square billets
- 4017 Flat block plants for rolling
- 4020 Flying shears
- 4030 Hot / cold cut-off grinding machines
- 4040 Cold circular sawing machines
- 4050 Profile steel roller straightening machines
- 4060 Rotary saws
- 4065 Second-hand finishing lines
- 4070 Packing lines
- 4080 Hot straightening and cutting-off machines

07.08. Rolls for hot rolling mills

- 4090 Work rolls
- 4100 Plate rolls
- 4110 Ingot rolls
- 4120 Slab rolls
- 4128 EcoRolls
- 4130 Fine iron and wire rolls
- 4135 Ferrous cast rolls
- 4140 Forged rolls
- 4160 Chilled cast iron rolls
- 4170 Tungsten carbide \ 057steel rolls
- 4180 Caliber rolls
- 4190 Billet and semi-finished rolls
- 4200 Straightening rolls
- 4210 Ductile iron rolls
- 4220 Cast steel rolls
- 4230 Back-up rolls
- 4240 Composite casting rolls
- 4250 Composite casting rolls in high chrome and indefinite materials
- 4260 Composite chilled cast rolls
- 4270 Composite rolls
- 4280 Rolls for tube mills
- 4290 Roll rings

07.09. Roll machining and machines

- 4300 EDT systems
- 4320 High wear resistant coatings on rolls etc.
- 4330 Caliber processing machines
- 4340 Caliber groove grinding and milling machines
- 4350 Groove milling machines
- 4355 Ring expanders
- 4360 Special machines
- 4370 Roll machining machines
- 4380 Roll turning machines
- 4390 Roll grinding machines
- 4395 Roll grinding wheels
- 4400 Roll blasting machines
- 4410 Lines for roll forming
- 4420 Roll surface, services

07.10. Components

- 4430 Decoilers and rewinders
- 4432 Decoiler components
- 4440 Drives, gearboxes and comb mill stands
- 4450 Strip cooling equipment
- 4460 Belt grinding machines
- 4470 Brakes
- 4479 Coil magnets
- 4490 Nozzles for descaling
- 4500 Nozzles for roll cooling
- 4503 Roll cooling (stainless steel)
- 4510 Electric rolls and roller tables
- 4515 Scrapers for hot strip lines up to 1000 °C

- 4520 Descaling systems with solid abrasives
- 4528 Descaling systems with high pressure water
- 4530 Descaling systems with liquid abrasives
- 4540 Colors for marking equipment
- 4550 Paint marking systems
- 4560 Grease lubrication systems
- 4570 Scarfing systems, hot and cold
- 4580 Scarfing equipment, machines and plants
- 4582 Scarfing plants, robot controlled
- 4590 Gear rollers
- 4600 Semi-finished product testing, sorting and fettling lines
- 4610 Decoilers
- 4630 Edging and shifting devices
- 4640 Marking lines for plates, slabs and tubes
- 4650 Marking systems for profiles, strips and sheets
- 4660 Marking lines for slabs and blocks
- 4680 Compactor and press binding lines for wire rod
- 4690 Cooling beds
- 4700 Reading systems for automatic identification of impact and directly applied marks
- 4710 Oil-hydraulic setting devices
- 4720 Oil and emulsion circulation systems
- 4730 Roller tables
- 4740 Rotating and stationary shear blades
- 4750 Lubrication systems
- 4760 Quick change stands
- 4770 Safety device for electrolift magnets
- 4780 Marking inks
- 4790 Marking pins for hot surfaces
- 4800 Steel strapping
- 4810 Stamping machines
- 4820 Stamping machines and stamps for hot and cold operation (also fully automatic)
- 4830 Stamps and tools
- 4840 Transport equipment for wide strapping
- 4850 Strapping machines for coils
- 4860 Heat exchangers
- 4870 Roll transport devices
- 4880 Roll cooling systems, controllable
- 4890 Roll matting systems
- 4892 Roll guides
- 4893 Roll rings
- 4897 Weighing systems for coils and bundles

07.11. Operating fluids

- 4900 Lubricants for hot rolling mills

07.12. Services

- 4920 High wear resistant coating on rolls etc.

08 Forging, extrusion

- 4930 Engineering and technical assistance
- 4940 Modernization of water hydraulic control systems

08.01. Forging machines

- 4950 CNC precision forging machines
- 4960 Open-die forging lines
- 4970 Die forging lines

- 4980 Die spraying plants
- 4985 Hot isothermal forging plants (HIF)
- 4990 Hydraulic forging presses
- 5000 Cold extrusion presses
- 5020 Presses, general
- 5030 Pressing and forging machines
- 5040 Radial forging machines
- 5050 Radial and axial die rolling machines and plants
- 5060 Radial forging machines
- 5061 Radial forging machines, hydraulic
- 5070 Ring blank presses
- 5080 CNC precision forging machines
- 5084 Forging rolls
- 5090 horizontal forging machines, upsetting machines

08.02. Extrusion presses

- 5100 Metal pipe and tube extrusion presses
- 5110 Steel pipe extrusion presses
- 5120 Extrusion presses for profiles

08.03. Components

- 5130 Brakes
- 5150 Forging manipulators
- 5155 Forging manipulators, rail-mounted
- 5160 Forging robots
- 5180 Transport manipulators
- 5184 Water hydraulic drive and control technology

08.04. Operating materials

- 5190 Lubricants for extrusion presses
- 5195 Heat resistant sliding materials

09 Powder metallurgy

- 5200 Engineering and technical assistance
- 5210 Powder Metallurgy

09.01. Hard alloys

- 5220 Hard alloys, general
- 5230 Machinable and hardenable hard alloys

09.02. Hard materials

- 5290 Tungsten carbide

09.03. Hard metal powders

- 5300 Iron, steel, alloy powders, non-ferrous metal powders
- 5310 Carbide powder

09.04. Additives

- 5320 Binder metals
- 5330 Organic additives

09.05. Machines and equipment for powder production

- 5340 Machines and equipment for water atomization
- 5350 Machinery and equipment for melt atomization
- 5360 Machines and equipment for spray drying
- 5370 Powder manufacturers

09.06. Machines and equipment for production of powder metallurgical products

- 5370 Plants, complete
- 5380 Hot and cold isostatic presses and plants
- 5390 Metal powder presses
- 5400 Presses
- 5405 Powder presses, hydraulic, mechanical, hybrid
- 5410 Protective gas furnaces
- 5420 Vacuum furnaces
- 5422 Vacuum pumps, dry running, for vacuum furnaces

09.07. Powder metallurgy manufactured products

- 5430 PM metals/sintered metals
- 5432 PM rolling rings
- 5440 PM steels
- 5450 Composite materials

09.08. Further processing of powder metallurgy products

- 5460 Plasma powder cladding
- 5470 Thermal spraying

09.09. Additive manufacturing

- 5475 3-D printing
- 5476 Additive manufacturing processes

- 5680 Annealing lines, inductive
- 5682 Annealing plants, continuous
- 5685 Modernization of annealing and pickling lines

10.05. Rolls for cold rolling mills

- 5686 Squeeze rolls
- 5690 Work rolls
- 5695 Spreader rolls
- 5700 Dressing rolls
- 5710 Polishing rolls
- 5715 Straightening rolls
- 5720 Straightening rolls
- 5730 Backing rolls
- 5750 Nonwoven rolls
- 5760 Rolls
- 5763 Roll sealing sleeves
- 5766 Roll core production and machining
- 5770 Rolls with polyurethane coating

10.06. Components

- 5780 Drives, gears and comb mill stands
- 5784 Strip guiding
- 5790 Tape remover
- 5800 Brakes
- 5803 Brake felt, stripper felt
- 5810 Letter and number types for stamping machines
- 5814 Labeling machines for rolled profiles (cold)
- 5830 Labeling machines
- 5840 Color marking machines
- 5845 Reel covers
- 5850 Reading systems for automatic identification of impact and directly applied characters
- 5860 Marking systems
- 5870 Oil circulation systems
- 5880 Rotating and stationary shear blades
- 5890 Marking inks for stamping machines
- 5900 Marking devices
- 5910 Marking pens for metals
- 5920 Steel strapping
- 5930 Stamping machines and stamps for hot and cold operation (also fully automatic)
- 5932 Roller cooling systems for high demands
- 5940 Heat exchangers
- 5950 Winding coils
- 5952 Weighing systems for bundles and coils

10.07. Operating materials

- 5960 Lubricants for cold rolling

- 6020 Descaling systems with liquid abrasives
- 6030 Free blasting systems
- 6040 Chamber blasting systems
- 6050 Shot peening systems
- 6060 Trough belt blast cleaning systems
- 6070 Roller table systems

11.02. Pickling plants

- 6080 Preparation of pickling baths
- 6088 Pickling lines, exhaust gas free, for stainless steel
- 6090 Pickling lines, complete
- 6100 Pickling lines for strip and wire
- 6109 Pickling tanks for high mechanical stress
- 6110 Pickling tanks and electrolysis cells for high mechanical stress
- 6120 Pickling baskets and hooks
- 6130 Pickling agents
- 6140 Pickling products for stainless steel
- 6150 Pickling products for stainless steels
- 6160 Pickling and surface treatment plants, general
- 6170 Pickling and surface treatment plants for wire
- 6180 Pickling additives
- 6190 Contract pickling plants
- 6192 Pumps for steel and stainless steel pickling
- 6200 Regeneration plants for pickling solutions
- 6203 Push pickling lines

11.03. Grinding and polishing machines

- 6210 Belt grinding machines
- 6230 Centrifugal grinding plants
- 6240 Polishing plants
- 6250 Drag grinding plants

11.04. Surface treatment plants

- 6260 Coil coating lines
- 6270 Strip edge trimming
- 6280 Strip processing and finishing lines
- 6282 Electrolytic strip pre-cleaning plants
- 6285 Strip washing lines
- 6290 Coating plants
- 6295 Burnishing plants and means
- 6300 CVD coating plants
- 6310 Services pickling and electropolishing of steel and stainless steel
- 6320 Oiling machines
- 6330 Electropolishing plants
- 6340 Deburring
- 6350 Deburring machines
- 6360 Color coating machines
- 6370 Paint spraying plants
- 6380 Vibratory finishing machines for surface treatment of metal parts
- 6386 High pressure water jet cleaning technology
- 6390 Shot peening
- 6400 Plastic coating plants
- 6410 Metal working equipment, electrochemical
- 6420 Metal degreasing lines
- 6430 Degreasing lines for metal strip
- 6440 Lines for cleaning and drying of metal
- 6450 Surface treatment, surface technology
- 6460 Surface treatment lines
- 6470 Surface drying, general
- 6480 Surface drying, inductive

10 Cold rolling

- 5480 Engineering and technical assistance

10.01. Cold rolling mills

- 5490 Strip, sheet, cold and metal rolling mills
- 5510 cold rolling blocks for wire
- 5520 Cold rolling mills, complete
- 5523 Modernization of cold rolling mills
- 5530 Second-hand cold rolling mills
- 5540 Rolling mills for flat products

10.02. Skin pass mills

- 5550 Skin pass mills
- 5555 Skin pass mills for hot and cold strip

10.03. Finishing lines

- 5560 Finishing lines
- 5570 Finishing machines
- 5580 Strip edge trimming lines
- 5590 Strip processing lines
- 5595 Spreader rolls
- 5600 Slitting and cut-to-length lines
- 5610 Slitting and cut-to-length machines
- 5620 Straightening machines for strips and sheets
- 5630 Roller levelers
- 5640 Stretch levelers for strip
- 5650 Current guide rolls
- 5660 Packaging lines

10.04. Annealing lines

- 5668 Continuous annealing
- 5670 Annealing lines
- 5672 Annealing and pickling lines

11 Surface treatment

- 5970 Engineering and technical assistance
- 5980 Descaling of sheet metal parts
- 5988 Titanium processing

11.01. Descaling equipment

- 5990 Bend descaling for strip
- 6000 Bending descaling for wire
- 6010 Descaling systems with solid abrasives
- 6018 Descaling systems with high pressure water

- 6490 Surface finishing
- 6500 Phosphating plants
- 6510 Phosphating process
- 6520 Plasma CVD coating systems
- 6525 Plasma generators, power supply
- 6527 Blank washing systems
- 6530 Plating plants
- 6540 Plasma CVD systems
- 6550 PVD coating systems
- 6565 Blasting plants
- 6570 Pretreatment plants for galvanizing plants
- 6580 Water demineralization for surface treatment

11.05. Aluminizing, tin plating, galvanizing

- 6600 Equipment for hot-dip galvanizing and aluminizing of strip
- 6603 Equipment for hot-dip galvanizing, tin-plating and aluminizing of strip
- 6610 Electrolytic galvanizing equipment
- 6620 Electrolytic galvanizing lines
- 6630 Hot dip galvanizing lines
- 6640 Hot dip galvanizing lines, accessories
- 6642 Hot dip galvanizing lines, zinc bath equipment
- 6648 Galvannealing
- 6650 Galvannealing, inductive
- 6660 High current lines for electrolytic galvanizing plants
- 6670 Galvanizing
- 6675 Tin plating plants
- 6680 Tin fusion, inductive

11.06. Corrosion protection

- 6690 Linings and coatings
- 6700 Coatings, inorganic
- 6702 Coatings, overlays, expert opinions
- 6710 Burnishing and corrosion protection
- 6720 Oilers
- 6730 Electrophoretic dip coatings
- 6740 Rubber coatings
- 6744 Corrosion protection systems
- 6750 Corrosion and oxidation protection
- 6755 Oil felt
- 6760 Powder coatings
- 6770 Rust protection paints
- 6780 VPI/VCI corrosion protection papers and films

11.07. Components

- 6790 Nozzles (also blow-off and descaling nozzles)
- 6795 Rubber and PU reel covers
- 6800 Rubber and PU roller covers for the sheet metal finishing industry
- 6810 Rubber rollers for the sheet metal finishing industry
- 6820 Spray pipes
- 6826 Weighing systems for coils and bundles

11.08. Operating materials

- 6830 Chips and compounds for vibratory finishing
- 6840 Wire grit
- 6860 Electrocorundum abrasives
- 6865 Bonded coatings

- 6870 Metal cleaners
- 6880 Phosphating agents
- 6890 Blasting glass beads
- 6898 Steel blasting media
- 6900 Blasting media and technology, general

11.09. Services

- 6906 Large format surface grinding
- 6910 Contract finishing

11.10. Wear protection

- 6914 Ceramic wear protection
- 6916 Linings and coatings
- 6918 Wear protection, metallic
- 6919 Wear protection, general

12 Production of bright steel and wire

- 6920 Engineering and technical assistance
- 6925 Second-hand equipment

12.01. Wire rod mills

- 6930 Wire and fine steel rolling mills
- 6940 Wire stretching machines
- 6950 Guiding equipment for wire rod and fine iron rolling mills
- 6960 Rolling machines for flat wires and wire profiles

12.02. Wire, bar and profile drawing

- 6965 Drawing tools
- 6970 Wire drawing machines
- 6980 Wire drawing machines
- 6990 Bar and profile drawing machines
- 7000 Bar drawing benches

12.03. Finishing lines for drawing shops

- 7010 Automatic stirrup bending machines
- 7020 Combi automatic machines
- 7030 Wire straightening and cutting machines
- 7040 Rotary peeling machines for bars and wire
- 7050 Bar straightening and polishing machines
- 7060 Peeling machines for bars
- 7065 Grinding machines
- 7070 Grinding machines for bars

12.04. Components

- 7080 Binding machines for wire rod, concrete and bar steel
- 7090 Brakes
- 7100 Seals for rolling mills
- 7110 Wire cooling lines
- 7120 Wire coil and coiling machines
- 7140 Wire and bar pointing machines
- 7150 Electric rolls and roller tables
- 7160 Colors for marking equipment
- 7170 Ink marking systems
- 7180 Hook web systems
- 7200 Compactor and press binding systems for wire rod
- 7210 Reading systems for automatic identification of impact and directly applied characters

- 7220 Marking systems
- 7230 Marking inks
- 7235 Spools for winding and unwinding, rewinding
- 7240 Stamping machines and stamps for hot and cold operation (also fully automatic)
- 7250 Heat exchangers

12.05. Operating supplies

- 7270 Lubricants and process materials
- 7280 Drawing agents (greases, oils, soaps, etc.)

13 Production of tubes / pipes

- 7290 Engineering and technical assistance
- 7295 Second-hand equipment

13.01. Tube rolling mills

- 7300 Expanding mills
- 7310 Diescher rolling mills
- 7320 Forming mills
- 7330 Sizing mills
- 7340 Reducing mills
- 7350 Pipe and expander mills
- 7360 Pipe rolling mills with planetary piercing mill
- 7370 Pitch rolling mills
- 7380 Plug rolling mills
- 7390 Stretch-reducing mills

13.02. Tube drawing machines

- 7400 Continuous drawing machines
- 7410 Tube drawing machines
- 7420 Drum drawing machines
- 7430 Drawing benches

13.03. Pipe welding machines

- 7440 Longitudinal seam pipe welding machines
- 7450 Pipe welding plants
- 7460 Spiral pipe plants

13.04. Finishing lines for tubes

- 7480 Finishing lines
- 7490 Finishing lines for tubes
- 7495 Deburring machines for tubes, profiles and solid bars
- 7500 Travelling cut-off machines
- 7510 Straightening machines for tubes, sections and bars
- 7520 Tube bending machines
- 7530 Pipe end calibrating and upsetting presses
- 7540 Pipe deburring equipment
- 7542 Pipe deburring machines
- 7544 Pipe straightening machines
- 7550 Pipe straightening presses
- 7560 Pipe straightening and cutting machines
- 7570 Pipe grinding machines (internal and external)

13.05. Components

- 7580 Binding machines
- 7600 Colors for marking equipment
- 7610 Paint signing machines
- 7615 Cleaning machines for tubes, profiles and solids

- 7620 Pipe pointing machines
- 7630 Pipe marking equipment
- 7640 Pipe testing equipment
- 7650 Pipe sawing machines
- 7660 Pipe spooling machines
- 7663 Automatic sawing machines
- 7665 Technical brushes

14 Sheet metal processing

- 7690 CAD constructions
- 7700 Spinning of sheet metal parts
- 7710 Spinning of sheet metal parts
- 7720 Engineering and technical assistance
- 7730 Cold forming of sheet metal parts and panels

14.01. Plants, presses, machines

- 7740 Bending machines
- 7750 Strip edge trimming machines
- 7760 Strip straightening machines
- 7765 Strip preparation lines for profilers
- 7780 Sheet metal round bending machines
- 7790 Sheet metal stacking machines, automatic
- 7800 Sheet metal forming
- 7810 Sheet metal working machines, general
- 7820 Flanging machines
- 7825 Pressure joining machines
- 7830 Deburring machines
- 7835 Deburring machines for tubes, profiles and solid bars
- 7840 Die bending presses
- 7845 Hot and cold riveting machines
- 7848 Hydraulic high-pressure sheet metal forming presses and lines
- 7849 Hydroforming (IHU)
- 7850 Hydraulic presses and plants
- 7860 Hydraulic presses for raw forming
- 7868 Internal high pressure forming
- 7870 Cold extrusion presses
- 7880 Cold forming lines
- 7882 Press feeding systems
- 7910 Roller profiling lines
- 7920 Round forming presses (presses)
- 7921 Wobble forming presses
- 7922 Special lines for coil processing
- 7924 Punching and pre-punching lines
- 7926 Dividing levelers
- 7930 Deep drawing presses
- 7940 Pre-rounding presses (presses)
- 7945 Feed straightening machines
- 7947 Roll feeders
- 7950 Roll forming of strip
- 7960 Tooling and sheet metal working machines, used

14.02. Slitting lines

- 7970 Strip slitting lines
- 7980 Sheet metal cut-to-length and cut-to-length lines
- 7990 Sheet metal cutting, laser cut
- 7995 Slitting blades and accessories for slitting lines
- 8010 Fine blanking lines
- 8015 High pressure water jet cutting technology
- 8020 Slitting and cut-to-length lines

- 8030 Slitting and cut-to-length machines
- 8040 Laser cutting systems
- 8050 Plasma cutting systems
- 8070 Cut-to-length lines
- 8072 Shears
- 8075 Shears (standing and flying) for sheet metal working
- 8080 Second-hand laser beam cutting machines
- 8090 Blast machine performance tuning
- 8100 Waste optimization systems

14.03. Welding technology

- 8110 Deposition welding on rollers etc.
- 8115 Fire protection blankets made of textile fabric
- 8120 Strip welding machines
- 8130 Stud welding machines
- 8140 Electron and laser beam welding (service)
- 8150 Electron beam welding machines
- 8170 Gouging machines
- 8180 Lattice girder welding machines
- 8190 Carbon electrodes (welding carbons)
- 8200 Mould welding
- 8205 Laser welding machines
- 8210 Laser beam welding machines
- 8215 Solder protection mats made of textile fabric
- 8220 MIG, MAG and TIG \ 057TIG welding torches
- 8230 Peripheral devices for robots
- 8250 Repair of cracks and engravings
- 8257 Rolling seam resistance welding equipment
- 8260 Repair welding
- 8280 Welding, general
- 8288 Welding wire
- 8290 Welding wire, stainless
- 8300 Welding wire and filler metals (also from CuAl alloys)
- 8310 Welding electrodes
- 8312 Welding protection blankets made of textile fabric
- 8314 Welding protection fabric up to 1250 °C
- 8316 Welding protection mats and curtains made of textile fabric up to 1250 °C
- 8318 Welding protection paste up to 1400 °C
- 8320 Welding constructions
- 8330 Welding machines, general
- 8340 Welding robots
- 8350 Welding technology, general
- 8360 Welding accessories, general
- 8363 Wire mesh welding
- 8370 Sensor systems for automated welding
- 8380 Butt welding machines, electric
- 8400 Resistance welding equipment

14.04. Components

- 8410 Brakes
- 8415 Color marking systems
- 8420 Laser marking equipment
- 8430 Plate stretcher
- 8435 Profile Stretchers
- 8440 Rotary shear blades and accessories
- 8450 Cutting and punching tools
- 8470 Marking pins for metals
- 8480 Deep drawing tools

14.05. Services

- 8481 Electron and laser beam welding
- 8482 Laser cutting of steels and sheet metal processing
- 8483 Laser welding
- 8484 Water jet cutting of steels
- 8485 Tube laser cutting
- 8486 Large format surface grinding

15 Steel products

15.01. Rolled steel

- 8489 Folded profiles, welded structural elements
- 8490 Aluminized sheet (hot-dip aluminized or roll clad)
- 8500 Aluminum-zinc coated steel sheet
- 8510 Antiphon sheets
- 8520 Elevator guide rails
- 8530 Strip steel, hot rolled
- 8540 Machined sheet
- 8550 Container bottoms
- 8560 Coated sheet (painted, foil coated)
- 8570 Reinforcing steel
- 8580 Reinforcing steel in coils, cold-rolled
- 8590 Reinforcing steel in coils, hot rolled
- 8600 Reinforcing steel in bars
- 8610 Reinforcing steel in bars and coils
- 8620 Reinforcing steel (stainless)
- 8630 Wide strip, organically coated
- 8640 Wide strip, cold rolled
- 8650 Wide strip, hot and cold rolled
- 8660 Wide flat steel
- 8670 Wide-flange beams
- 8672 Cellform beams
- 8680 Electrical sheet and strip
- 8690 Enameled steel sheet
- 8700 Thin sheet in further processed special designs
- 8710 Thin sheet, cold-rolled
- 8720 Thin sheet, surface finished
- 8740 Sheet products, laser welded
- 8750 Sheet products, mash-seam welded
- 8760 Flat steel
- 8769 Sectional steel
- 8770 Shaped steel (incl. pit lining)
- 8780 Welded sections
- 8790 Heavy plate
- 8795 Heavy plate blanks
- 8800 Heavy plate products, pressed, dimpled, bent, edge-finished
- 8810 Heavy and medium plate, incl. lining plate
- 8820 Semi-finished products
- 8830 Semi-finished products, continuously cast
- 8831 Semi-finished products, continuously cast, ingot
- 8840 Semi-finished products for rolling
- 8850 Semi-finished products for forging
- 8860 Superstructure material
- 8870 Clad steel sheet
- 8880 Rails
- 8890 Shipbuilding material
- 8900 Shipbuilding profiles
- 8910 Forging semi-finished products
- 8915 Forged bars
- 8920 Slit strip

- 8922 Slit strip, surface finished
- 8930 Cold drawn special steel sections
- 8940 Special profiles, hot rolled
- 8950 Special profiles, hot rolled and drawn for lift trucks, vehicle, machine and pipeline construction
- 8960 Special profiles, hot extruded
- 8970 Bar steel (quality, case-hardened, quenched and tempered, spring, free-cutting)
- 8975 Bar steel (angle steel)
- 8976 Steel bars (stainless steel, all dimensions)
- 8980 Steel sheet piling sections (box piles and accessories, driven steel piles)
- 8981 Steel sheet piling sections (box piles and driven steel piles)
- 8985 Steel sheet pile sections, box piles, steel piles, anchoring and accessories
- 8990 Continuous cast billets
- 8992 Trapezoidal profiles - PUR and mineral wool, sandwich elements, acoustic elements, cassettes
- 9010 Galvanized steel strip
- 9020 Galvanized profiled steel sheet
- 9030 Galvanized steel sheet in sheets and rolls, galvanized strip steel
- 9040 Honeycomb beams, machined beams
- 9050 Wire rod
- 9060 Wire rod, flat or round
- 9070 Wire rod, round
- 9080 Wire rod in spring steel grades
- 9090 Wire rod in cold heading grades
- 9100 Wire rod in welding wire grades
- 9130 Rolled steel
- 9140 Hot wide strip
- 9150 Tinplate and strip, ultra-fine sheet and strip, tin-plated sheet and strip, special chrome-plated ultra-fine sheet and strip (ECCS)
- 9160 Y-sleepers

15.02. Pipes

- 9170 Fittings for pipes, stainless
- 9180 Large-diameter pipes
- 9190 Large diameter tubes, spiral welded
- 9200 Boiler tubes
- 9220 Flanges, stainless
- 9230 Oilfield tubes
- 9260 Clad tubes
- 9270 Precision steel tubes, welded
- 9280 Precision steel tubes, seamless and welded (round, oval, square, rectangular and as special sections)
- 9290 Precision steel tubes, seamless and welded, with surface finishing such as electrogalvanizing, chromating, phosphating, etc.
- 9300 Tubes prematerial (round and square)
- 9310 Tubes
- 9320 Tubes made of degussite
- 9330 Tubes made of cold-tempered steels, weldable fine-grained steels
- 9332 Tubes, ceramic
- 9334 Tubes of circular or square cross-section
- 9335 Tubes, circular or square cross-section, hot-dip galvanized
- 9340 Stainless steel tubes
- 9345 Pipe parts and components

- 9350 Tube products (U-tubes, also with special radii, coil systems, etc.)
- 9360 Centrifugally cast tubes (also made of stainless steel)
- 9370 Special section tubes, welded, cold-rolled
- 9380 Steel drainage pipes, hot-dip galvanized
- 9390 Steel pipes, machined
- 9400 Steel pipes, welded
- 9410 Steel tubes, seamless
- 9420 Door reinforcement tubes, welded
- 9430 Door reinforcement tubes, seamless
- 9440 Cylinder tubes

15.03. Forgings

- 9450 vessels (flanges, nozzles, etc.)
- 9460 Products for general engineering (crankshafts, tools, gears, etc.)
- 9470 Products for power engineering (generator parts, turbine parts, etc.)
- 9480 Products for aircraft engine construction (e.g. compressor blades, disks)
- 9490 Products for shipbuilding
- 9500 Open die forgings, general
- 9510 Die forgings, general
- 9520 Seamless rolled rings
- 9530 Forgings, general
- 9532 Non-ferrous forgings (copper and copper alloys, aluminum alloys)

15.04. Railroad rolling stock

- 9540 Axles
- 9550 Wheel tires

15.05. Steel in the following delivery forms

- 9560 Structural steels, general
- 9570 engineering steels, case-hardening steels, quenched and tempered steels, surface-hardening steels, low-temperature steels, cold-heading steels, fine-grained steels, steels resistant to compressed hydrogen
- 9580 Stainless steel special remnants (Ia and IIa quality)
- 9590 Stainless steels
- 9600 Case hardening steels, foreign standard steels, wear resistant steels
- 9610 Case-hardened steels, nitriding steels, spring steels, foreign standard steels, wear-resistant steels
- 9618 ESU remelted steels
- 9620 Spring steel wire, stainless
- 9625 Thin sheets
- 9630 High temperature steels and alloys
- 9635 Perforated plates
- 9638 Cold rolled sections
- 9640 Stainless bars and tubes
- 9641 Stainless bars
- 9642 Special sections, hot rolled, hot extruded or drawn
- 9650 Stainless, acid and heat resistant steels
- 9655 Stainless, acid and heat resistant steels and alloys
- 9660 Stainless, acid- and heat-resistant steels and alloys, also heating conductor and resistance alloys
- 9670 High-speed steels
- 9680 Special structural steels, alloyed, weldable

- 9685 Engineering steels, alloyed, weldable
- 9690 Steels with special physical properties
- 9696 Chromium-plated steels
- 9700 Pre-machined steels in bars and plates, rough milled, fine milled, ground
- 9710 Rolling bearing steels
- 9714 Mild unalloyed steels
- 9718 Tool steels, hardened
- 9720 Tool steels, alloyed and unalloyed

15.06. Drawing and cold rolling mill products

- 9730 Bright steel (including free-cutting bright steel, bright steel shafts, bright special sections)
- 9740 Spring steel strip
- 9750 Cold rolled strip
- 9751 Hardened strip steel
- 9755 Cold rolled strip, coated
- 9760 Cold rolled strip with bright surface
- 9770 Cold rolled strip with refined surface
- 9780 Cold rolled clad strip
- 9790 Cold rolled profiles from hot rolled or cold rolled strip
- 9800 Cold rolled profiles with refined surface
- 9810 Body parts
- 9814 Sheet metal formed parts
- 9817 Precision strip steel
- 9820 Pressed, stamped and drawn parts
- 9830 Steel strip for packaging purposes
- 9838 Tailored beams
- 9840 Tailored blanks (sheet blanks)
- 9850 Formed tube and sheet components for the automotive industry
- 9860 Drawing and cold rolling mill products
- 9870 Cylinder tubes for hydraulics and pneumatics

15.07. Wire and wire products

- 9880 Anchor steel, screwable
- 9885 Structural steel mesh
- 9890 Reinforcing wire, reinforcing mats, pit mats
- 9900 Reinforcing meshes for reinforced concrete
- 9920 Wire meshes
- 9930 Wire mesh
- 9932 Wire mesh
- 9950 Wire ropes and strands
- 9960 Wire and wire products
- 9970 Iron, free-cutting, cold extrusion and cold heading wires
- 9980 Iron fine and superfine wires
- 9990 Iron and steel wire, drawn
- 10000 Spring steel wire, oil hardened
- 10010 Spring steel wire, unalloyed
- 10015 Profile wire
- 10020 Flat and shaped wires
- 10025 Threaded steel
- 10030 Other wire products
- 10035 Prestressing steel
- 10040 Prestressing steel, prestressed concrete strands
- 10050 Galvanized and PVC coated iron wire

15.08. Steel construction

- 10058 Car lifts, mobile
- 10060 Automatic reinforcement station
- 10070 Sheet metal structures

- 10080 Bridge construction
- 10090 Hall construction
- 10100 Masts
- 10110 Steel construction, general
- 10115 Joining technology in steel construction, general
- 10120 Steel construction, general
- 10130 Assembly hall construction

15.09. Services

- 10140 Deep hole drilling, contract
- 10141 Deep hole drilling, horizontal
- 10145 Forming and smoothing
- 10146 Cutting tool steel

16 Furnace and energy technology

- 10150 Engineering and technical assistance
- 10152 Waste gas systems behind electric arc furnaces
- 10154 Waste heat systems behind walking beam furnaces and pusher furnaces
- 10160 Complete heating systems
- 10170 Furnace optimization (conversion to low NOx combustion)
- 10180 Process control systems for industrial furnaces and energy plants
- 10190 Rational use of energy

16.01. Rolling mill furnaces

- 10200 Deep annealing furnaces
- 10210 Rolling mill furnaces, induction
- 10220 Rolling mill furnaces

16.02. Forging furnaces

- 10230 Forging furnaces
- 10240 Forging furnaces, gas fired
- 10250 Forging furnaces, induction

16.03. Roller Hearth Continuous Furnaces

- 10260 Roller Hearth Continuous Furnaces
- 10270 Roller hearth and walking beam furnaces

16.04. Continuous furnaces for wide strip

- 10280 Strip heating, inductive
- 10290 Strip edge heating, inductive
- 10300 Continuous furnaces for wide strip

16.05. Top-hat furnaces

- 10310 Top-hat furnaces
- 10320 Top and pot annealing furnaces

16.06. Vacuum furnaces

- 10330 Vacuum annealing furnaces
- 10340 Vacuum hardening furnaces
- 10341 Vacuum pumps, dry running, for vacuum furnaces

16.07. Hardening and tempering equipment

- 10350 Quenching baths
- 10355 Carburizing furnaces
- 10360 Hardening furnaces

- 10370 Hardening plants, general
- 10375 Hardening and tempering plants, electrically heated
- 10380 Hardening and tempering plants, gas heated
- 10390 Hardening and tempering plants, with inductive heating
- 10400 Hardening and tempering plants, with resistance heating
- 10401 Laser hardening systems
- 10403 Nitriding furnaces

16.08. Heating furnaces and heat treatment plants

- 10408 Continuous furnaces
- 10410 Co-step furnaces
- 10420 Hardening furnaces
- 10430 Bogie hearth furnaces
- 10440 Induction heating plants
- 10450 Industrial furnaces, used
- 10460 Chamber furnaces
- 10470 Conductive heating plants
- 10480 Furnaces with mechanically driven hearth
- 10490 Patenting plants for wire
- 10500 Plasma nitriding plants
- 10505 Radiators
- 10510 Roller hearth and walking beam furnaces
- 10520 Pit furnaces
- 10530 plug furnaces
- 10540 Pusher-type, roller and rotary hearth furnaces
- 10545 Tempering and drying plants
- 10550 Vertical and horizontal strip furnaces for heat treatments
- 10560 Heat treatment plants
- 10562 Heat treatment furnaces (continuous and discontinuous)
- 10570 Heat treatment furnaces for batch operation, open heated

16.09. Bath furnaces

- 10580 Aluminum melting furnaces
- 10582 Aluminum melting and holding furnaces
- 10590 Furnaces and plants for lead coating, galvanizing and tinning
- 10600 Salt and metal bath furnaces

16.10. Industrial furnaces for special purposes

- 10610 Furnaces for the ceramic industry
- 10615 Lime kilns
- 10620 Inert gas, vacuum furnaces
- 10630 Tempering furnaces
- 10640 Drying furnaces for casting cores, molds and mold covers
- 10650 Drying furnaces for stopper rods
- 10652 Microwave ovens/dryers
- 10660 Accessories for industrial furnaces

16.11. Protective gas plants

- 10670 Protective gas plants

16.12. Insulations

- 10680 Block insulation
- 10690 Firing pads
- 10700 Calcium silicate

- 10710 Insulation materials
- 10720 Vibration protection
- 10730 Backing insulation
- 10732 Electrical insulation systems for arc furnaces and transformer houses
- 10735 Heat protection and insulation products
- 10740 Insulating and sealing boards, asbestos-free
- 10744 Insulating fabrics up to 1260 °C
- 10746 Insulating cords, tapes, packings and hoses up to 1260 °C
- 10748 Support arm insulations, asbestos-free
- 10750 Insulating bricks
- 10760 Cooling pipe insulations
- 10770 Furnace components
- 10780 Sound insulation
- 10790 Vibration insulation
- 10800 Thermal insulation
- 10803 Wool felt for bright annealing furnaces

16.13. Components

- 10805 Exhaust technology
- 10810 Bath rollers
- 10820 Belt coolers, belt dryers
- 10830 Block pressers
- 10840 Block and slab pushers for heating furnaces
- 10850 Burners for gas and oil
- 10860 Custom-made burners
- 10870 Feeding and discharging machines
- 10880 Electric heaters
- 10890 Natural gas burners
- 10895 Furnace probes (for the use of video cameras)
- 10900 Gas burners
- 10910 Generators for protective and reaction gases
- 10915 Hardeners
- 10920 Heating conductors
- 10930 Hearth rollers
- 10950 pulverized coal furnaces (also -plants)
- 10960 Laser light barriers
- 10970 Oil burners
- 10990 Furnace riders
- 11000 Furnace rollers
- 11005 Plasma generators
- 11010 Regenerative burners
- 11020 Recuperative burners
- 11028 Recuperators
- 11030 Recuperators, regenerators
- 11040 Rollers (e.g. from SIC)
- 11050 Safety devices for EAF oxygen-fuel burners
- 11060 Jet tubes
- 11070 Radiant tube burners
- 11078 Vacuum pumps, dry running, for vacuum furnaces
- 11080 Heat exchangers
- 11090 Heat recovery systems
- 11092 Weighing systems for melting furnaces
- 11093 Wool felt for bright annealing furnaces

16.14. Operating materials

- 11110 Hardening agents (also hardening powders and carbon restoration agents)
- 11120 Hardening oils
- 11150 Fire-resistant hydraulic fluids

- 11160 Polymer solutions
- 11170 Lubricants
- 11180 Spray cleaners
- 11190 Heat transfer fluids

16.15. Services

- 11200 Energy consulting
- 11210 Energy saving
- 11215 Commissioning, maintenance and service of heating equipment
- 11240 Planning and projecting of energy-technical plants

17 Refractory technology

- 11245 Product know-how for basic refractory bricks and mixes
- 11248 Monitoring of refractory components

17.01. Raw materials, precursors and binders for refractory materials

- 11250 Aluminum hydroxide
- 11260 Alumina, alumina
- 11263 Reinforcing wires for refractory mixes
- 11265 Binders for the production of refractory materials
- 11270 Electrocorundum
- 11280 Graphite
- 11290 Adhesive sand
- 11300 Coke breeze
- 11310 Coke breeze, dry
- 11320 Magnesium oxide
- 11330 Microsilica
- 11360 Silicon carbide
- 11366 Titanium dioxide
- 11370 Clays
- 11380 Alumina specialties
- 11390 Zirconia

17.02. Plants for the production of refractory materials

- 11400 Equipment for the production of refractory materials

17.03. Refractory materials and equipment

- 11410 Tapping stones for converters and electric arc furnaces
- 11420 Painting, filling and plastering materials
- 11430 Basic ramming, gunning and casting mixes
- 11440 Basic bricks (magnesia, magnesia-chromium, chromium ore, chromite, dolomite, spinel, forsterite and carbon bricks)
- 11450 Calcium silicate
- 11460 Dolomite products
- 11470 Electrode masses
- 11480 Fiber ceramic moldings, vacuum formed
- 11481 Fiber ceramic moldings, vacuum formed, up to 1750 °C
- 11485 Fiber mats and felts up to 1600 °C
- 11490 Fiber products, ceramic
- 11500 Prefabricated parts, refractory
- 11510 Refractory concrete

- 11512 Refractory concrete, high strength, for industrial floors
- 11520 Refractory products, general
- 11530 Refractory ramming mixes
- 11540 Refractory anchorages
- 11550 Refractory material
- 11560 Lightweight refractory bricks
- 11570 Lightweight refractory and insulating mixes
- 11580 Lightweight refractory and insulating bricks
- 11590 Gas purging equipment, refractory
- 11600 Pouring mixes, self-flowing
- 11610 hearth masses
- 11620 High-fire bricks
- 11630 Blast furnace bricks
- 11640 Induction furnace mixes
- 11650 Insulating material, asbestos-free
- 11660 Isostatically pressed products
- 11670 Carbon and graphite bricks
- 11690 Converter bricks
- 11700 Arc furnace bricks
- 11710 Perforated bricks
- 11720 Masses, refractory (general)
- 11725 MgO-C bricks
- 11730 Mortars and mastics, refractory
- 11740 Mux masses
- 11750 Ladle masses
- 11752 Torpedo ladle lining
- 11755 Ladle lining, monolithic
- 11760 Ladle bricks
- 11768 Products made of \ 050HTW \ 051 high temperature wool
- 11790 Gutter and taphole masses
- 11800 Gutter lining, cooled
- 11810 Acid resistant bricks
- 11820 Acid ramming and centrifugal masses
- 11830 Firebricks
- 11840 Shadow pipe
- 11850 Slide gate ceramics
- 11860 Cast basalt
- 11865 Protective blankets made of textile fabric, refractory
- 11870 Silicon carbide bricks
- 11880 Silica bricks, tondina bricks
- 11886 Special adhesives up to 1200 °C
- 11890 gunning and repair compounds
- 11900 Steel mill wear material
- 11910 ramming, casting and vibrating masses
- 11915 ramming, spraying and casting compounds
- 11920 Stoppers and spouts
- 11930 Continuous castings, refractory
- 11940 Immersion tube, monota immersion spout
- 11950 Technical ceramics
- 11960 High-alumina bricks (andalusite, bauxite, corundum, mullite, sillimanite bricks)
- 11970 Torpedo mixer stones
- 11980 Tundish masses
- 11985 Pouring compounds, cement-free, for blast furnace tapping troughs
- 11990 Vermiculite
- 12000 Thermal insulation materials, asbestos-free
- 12004 Vacuum formed parts
- 12005 Vacuum formed parts, without ceramic fibers
- 12010 Wollastonite

- 12020 Zircon nozzles
- 12030 Zircon containing stones
- 12040 Zircon sand / flour)

17.04. Processing of refractory materials

- 12050 Processing of used refractory materials
- 12060 Testing of FF materials

17.05. Machines for refractory construction

- 12070 break-out hammers, pneumatic and hydraulic, for electric furnaces, converters, ladles and troughs
- 12071 Excavation robots
- 12075 Chipper
- 12080 Converter tap hole repair vehicles
- 12095 Converter lining devices
- 12100 Manipulators for FF masses
- 12110 Ladle spraying machines
- 12118 Pumping machines for refractory materials
- 12120 Pumping machines for refractory materials
- 12130 Centrifugal machines for FF-masses
- 12140 Spraying machines for FF materials
- 12150 Tamping plants, autom., for ladles

17.06. Refractory construction

- 12160 lining of all kinds of furnaces
- 12170 Firing chambers
- 12175 Refractory anchors
- 12180 Refractory construction
- 12190 Refractory ramming mixes
- 12200 Suspended ceilings

17.07. Services

- 12204 Training - Refractory
- 12205 Refractory maintenance at operating temperature
- 12206 Refractory systems

18 Machinery and plant engineering

- 12210 Plant engineering, general
- 12220 CAD design
- 12230 Engineering and technical assistance
- 12240 beams, columns, shafts
- 12250 Industrial Engineering
- 12258 Standard parts for cutting and punching tool construction
- 12260 Cleaning and cleaning materials
- 12270 Second-hand machines (purchase and sale)
- 12280 Special constructions
- 12285 Heat exchangers
- 18.01. Mining equipment, machines and supplies**
- 12290 Plants and machines for underground mining
- 12300 Bucket elevators
- 12309 Conveyor systems
- 12310 Conveying plants and machines
- 12330 Mine support profiles

18.02. Chemical plants and accessories

- 12350 Tank and apparatus construction
- 12360 Liquid gas - storage stations
- 12370 Gas tanks
- 12390 Acid chimneys
- 12400 Acid and chemical resistant plants and equipment
- 12410 Nitrogen production plants

18.03. Steam generation plants and equipment

- 12425 Exhaust gas technology
- 12430 Waste heat boilers
- 12440 Steam filters
- 12450 Steam boilers, general
- 12460 Pressure boilers
- 12470 Hydrazine removal
- 12480 Pulverized coal firing systems

18.04. Foundry equipment, machinery and supplies

- 12354 Casting ladles
- 12500 Molding machines
- 12530 Foundry equipment, machines and supplies
- 12535 Foundry tools
- 12540 Foundry consulting and engineering
- 12542 Foundry software
- 12550 Core shooters
- 12560 fettling machines
- 12570 Robots
- 12580 Sand mixers
- 12586 Melting furnaces, inductive
- 12590 Shaking ladles
- 12592 Crucible tongs
- 12605 Vacuum investment casting plants-superalloys
- 12607 Vacuum investment casting plants with cold crucibles for titanium or titanium alloys

18.05. Power plants and power stations

- 12610 Power plants and power stations, steam
- 12620 Power plants and power stations, electric

18.06. Ventilation plants and equipment

- 12630 Blowers
- 12635 Industrial fans
- 12650 Air conditioners, general
- 12660 Air conditioners for heat plants
- 12670 Air conditioners for crane lances, crane bridges, etc.
- 12690 Expansion joints
- 12700 Ventilation ducts
- 12710 Ventilation systems and equipment, general
- 12720 Natural ventilation
- 12730 Induced draught systems and equipment
- 12740 Ventilators

18.07. Water treatment plants, equipment and accessories

- 12750 Chemical water treatment
- 12760 Pressurized water plants and accumulators
- 12770 Filtering plants for circulating water
- 12780 Rubber compensators

- 12790 Cooling towers
- 12793 Cooling water / circulating water systems
- 12796 Magnetic filters
- 12800 Press water additives
- 12810 Water treatment systems
- 12830 Water demineralization, treatment and recycling
- 12840 Water recooling systems
- 12846 Water filtration

18.08. Other plants

- 12848 Chillers
- 12850 Slag granulation hoses
- 12860 Slag recycling plants (also slag granulation plants)
- 12862 Slag granulation plants
- 12870 Lube oil plants

18.09. Maintenance

- 12880 Spare parts and consumables
- 12890 Maintenance, general
- 12892 Maintenance organization
- 12894 Maintenance systems
- 12896 Repair, overhaul and modernization of machine tools
- 12900 Maintenance of large gear units
- 12920 Maintenance of continuous casting plants for ingots and slabs
- 12930 Maintenance of continuous casters for ingots and billets
- 12950 Repair of ingot molds
- 12960 Repair of ingot molds
- 12964 Cooling system cleaning
- 12970 Ladle repair, FF
- 12980 Repairs, spare parts
- 12983 Software for maintenance
- 12990 Preventive maintenance
- 13000 Heat exchanger cleaning
- 13010 Condition based machine maintenance

18.10. Power and work machines

- 13020 Steam turbines
- 13021 Gas turbines
- 13030 Rotary compressors
- 13040 Compressed air equipment
- 13050 Natural gas, gas transmission compressor stations
- 13060 Natural gas HP storage
- 13070 Piston pumps
- 13080 Piston compressors
- 13083 Corrosion resistant pumps
- 13090 Centrifugal pumps
- 13100 Mixing units for all fuel gases
- 13120 Lubrication pumps
- 13130 Screw compressors
- 13150 Turbo compressors
- 13160 Vacuum pumps

18.11. Gearboxes and drive elements

- 13168 Drive elements
- 13170 Drive engineering
- 13174 Valve gearboxes
- 13180 Brakes
- 13190 Brake disc mounting
- 13195 Torque limiter
- 13200 Flange couplings

- 13210 Cardan joints
- 13220 Cardan shafts
- 13230 Gear rollers
- 13240 Gearboxes and drive elements
- 13250 Large gearboxes
- 13255 Chain drives and sprockets
- 13260 Hirth serration
- 13261 Hirth spur gearing
- 13270 Couplings
- 13285 Couplings, flexible, elastic
- 13290 Couplings, mechanical and hydrodynamic
- 13300 Planetary gearboxes
- 13308 Slew drives
- 13310 Safety couplings
- 13318 Spindles
- 13320 Special constructions
- 13350 Shaft-hub couplings (backlash-free)
- 13360 Shaft couplings (rigid)
- 13370 Winding shafts
- 13380 Gear drives
- 13390 Gear wheels
- 13395 Gearbox repairs

18.12. Bearings

- 13400 Slewing rings
- 13404 Elastomeric bearings
- 13406 Spherical plain bearings / rod ends
- 13410 Plain bearings
- 13420 Ceramic-metal compact plain bearings
- 13430 Ball bearings
- 13440 Cam rollers
- 13460 Linear systems
- 13470 Roller bearings
- 13480 Yoke type track rollers
- 13484 Thermal separation
- 13485 Support and guide rollers
- 13490 Rolling bearings
- 13492 High-temperature rolling bearings
- 13500 Roller bearings

18.13. Oil hydraulic systems, equipment and accessories

- 13508 Rotary distributors
- 13510 Rotary feeders
- 13520 Pressure measuring, switching and writing devices
- 13530 Pressure switch
- 13540 High pressure flange connectors
- 13550 Hydraulic systems
- 13560 Hydraulic and shaft seals
- 13570 Hydro gears
- 13580 Hydro motors
- 13590 Hydro pumps
- 13595 Hydraulic accumulators
- 13600 Hydro valves
- 13610 Hydraulic cylinders
- 13620 Oil hydraulic systems, devices and accessories
- 13630 Vibration dampers
- 13640 Servo valves
- 13645 Continuous valves
- 13660 Complete plants, oil hydraulic
- 13670 Water hydraulic

18.14. Control systems and components

- 13680 Shut-off valves

13690 Automatic inflow control
with distribution gate valves
13695 Torque limiters
13710 Electro-hydraulic actuators
13718 Electro-servo cylinders
13720 Multipoint single
and multi-purpose regulators
13730 Control systems, complete
13740 Control valves
13760 Actuators
13780 Continuous single
and multi-purpose regulators

18.15. Piping and accessories

13786 Exhaust gas technology
13790 Butterfly valves
13800 Asbestos-free fabric expansion joints
13810 Fittings
13820 Flanges
13840 Rubber expansion joints
13850 High pressure pipe technology
13859 Safety valves
13860 Expansion joints
13890 Pipe break safety valves
13900 Pipe swivels
13910 Piping and accessories
13920 Pipeline construction
13930 Piping accessories
13940 Check valves
13945 Hoses
13947 Flexible hoses with ceramic wear protection
13950 Plug-in disc gate valves

18.16. Stranding machines

13955 Stranding machines
13958 Rope making machines

18.17. Tool and model making

13956 Mold frames, mold assemblies
13960 Materials for model
and prototype construction
13970 Model and prototype making

18.18. Machine tools

13980 Cutting-off machines
13990 External thread cutting machines
14000 Band sawing machines
14010 Bending and straightening machines
14015 Slab sawing machines
14020 Wire working and processing machines
14030 Flow-forming machines
14040 Milling machines
14060 Spark erosion machines
14070 honing and lapping machines
14080 Cable sheathing presses
14081 Cable sheathing presses
(lead and aluminum)
14088 Sharpening machines
14090 Cold circular saws
14095 Hot circular saws
14100 Mould processing machines
14120 profile and flat shears
14130 Shears (standing, flying)
for metallurgical operations
14140 Shears (standing, flying)
for sheet metal working

14150 Shearing centers
14160 Grinding and polishing machines
(also internal)
14170 Special machines for chip forming
14180 Special machines for chipless forming
14190 Special machines for special tasks
14195 Concrete sawing machines
14200 Stone cutting saws
14210 Plate shears
14220 Cut-off machines

18.19. Tools

14230 Press brake tools
14240 Drills
14242 Taphole drilling tools
14250 Diamond tools
14260 Pneumatic tools
14280 Carbide (also metal carbide)
14290 Tungsten carbide inserts
and molded parts
14300 Carbide tools
14302 HM tipped saw blades
14304 HP grinding wheels
14306 Saw bands and blades for metallic
and non-metallic materials
14310 Saw blades for metal
14318 Cutters
14320 Shear blades
14323 Splitting knives and accessories
for splitting lines
14330 Abrasives and grinding wheels
14334 Special tools for die casting industry
14336 Cutting wheels
14337 Roll grinding wheels
14338 Cutting and special tools

18.20. Clamping technology

14380 Clamping hydraulics
14400 Clamping elements
14401 Clamping tools, screws

18.21. Components

14410 Seals
14412 Seals with high chemical
and thermal resistance
14420 Rotary seals for feeding gases
or liquid media
14430 Cooling water circulation units
for continuous casting-rolling lines
14440 Nozzles
(also blow-off and descaling nozzles)
14450 Pistons
14460 Metal hoses
14470 Buffers (rubber and cellular buffers)
14480 Stuffing box packings
14490 Wear plates

18.22. Operating fluids

14500 Solid lubricants
14510 Industrial oils
14520 Cooling lubricants

18.23. Tribology

14522 Dosing and monitoring equipment
for lubricants

14523 Oil circulation systems for bearing
and gear lubrication
14524 Two-line grease lubrication systems
for metallurgical plants and rolling mills
14525 Special lubricants
14526 Central lubrication systems
14527 Machines for degreasing and lubrication

18.24. Services

14528 Service for compressors and turbines
14529 Mechanical processing of hydraulic parts

19 Transport and storage technique

14530 Engineering and technical assistance
14535 Hot material conveyors
14540 Transport and logistics for industrial
residues
14545 Hot material conveyors
14548 Transport
14550 Transport technology

19.01. Metallurgical plant vehicles

14560 Slab, bloom and billet transporters,
rubber tires
14570 Coil transport systems
14580 Coil transporters
14590 Steel mill vehicles, general
14600 Metallurgical plant vehicles, track-bound
14605 Air cushion vehicles-FTS
14610 Slag ladle transporters
14620 Slag transporter
14630 Scrap transport trailers
with weighing equipment
14640 Steel mill vehicles

19.02. Rail vehicles

14650 Diesel locomotives
14660 Railroad wagons
14670 Self-propelled wagons

19.03. Track technology

14680 Turntables and transfer cars
14684 Track technology
14690 Shunting systems

19.04. Trackless vehicles

14700 Trailers
14705 Trucks and trailers
14720 Electric industrial trucks
14730 Electric trucks
14734 Electric four-way sideloaders
14740 Driverless transport systems
14742 Driverless transport systems
for steel and aluminum coils
14750 Forklifts and cross stackers
14760 Rubber-tired heavy-duty
transport vehicles
14810 Heavy-duty tractors
14820 Telescopic excavators
14822 Transport systems for coils

19.05. Continuous conveyors

14830 Conveyors (general)

- 14840 Pneumatic conveyors
- 14850 Vibratory conveyors
- 14860 Vertical conveyors
- 14880 Steep conveyors
- 14890 Continuous conveyors for bulk material
- 14900 Continuous conveyors for piece goods
- 14910 Conveyor belts and screws
- 14920 Trough chain conveyors

19.06. Cranes

- 14930 Slewing cranes
- 14940 Casting cranes
- 14945 Crane systems, automatic
- 14946 High capacity automatic cranes
- 14950 Cranes, hoists and accessories, general
- 14955 Crane service
- 14960 Overhead travelling cranes
- 14970 Gantry cranes
- 14980 Bracket cranes
- 14990 Buffers
- 14992 Vacuum lifting devices for heavy industry
- 14993 Automatic stacking devices (vacuum lifting devices)

19.07. Scales

- 14997 Bundle and coil scales
- 15000 Batching and blending scales
- 15010 Track and truck scales
- 15020 Crane scales
- 15030 Roller table scales
- 15040 Scales for continuous weighing
- 15041 Scales for alloying elements
- 15042 Scales for pig iron
- 15043 Scales for scrap
- 15044 Scales for static weighing
- 15045 Scales for stationary weighing
- 15050 Weighing systems for ladle turrets and ladle cars
- 15060 Load cells
- 15080 Weighing systems for silos

19.08. Storage and retrieval systems

- 15090 Bund high-bay warehouse
- 15100 Container staging systems
- 15110 Labeling systems
- 15120 Lattice girder storage systems
- 15130 Manual overhead conveyors
- 15134 Aerial work platforms
- 15140 Storage technology and automation systems for sheet metal, long goods and stacking boxes
- 15141 Storage technology and automation systems for sheet metal, long goods and stacking boxes
- 15150 Storage and retrieval systems
- 15155 Storage systems for coils
- 15160 Storage and racking systems
- 15164 Long goods order pickers, high rack stackers
- 15170 Marking systems
- 15180 Pallets and cassettes
- 15188 Vertical elevators (paternosters)
- 15190 Stacker cranes
- 15193 Traversers and turning devices
- 15195 Honeycomb racking systems

19.09. Warehouse organization

- 15198 Labels
- 15200 Identification
- 15208 Warehouse logistics
- 15210 warehouse organization)

19.10. Components

- 15220 Slings equipment
- 15230 Loading and unloading equipment
- 15240 Sheet metal package tongs
- 15250 block pushers, extractors
- 15270 Bunker discharge aid
- 15280 Bunker and silo equipment
- 15290 Coil and sheet metal packaging
- 15300 Coil tongs
- 15310 Permanent magnets
- 15320 Electrical equipment for cranes etc.
- 15330 Electric hoists
- 15333 Distance measuring devices for cranes
- 15335 Labels
- 15340 Conveyor belt cover
- 15350 Conveyor belt scraper
- 15360 Conveyor devices and equipment
- 15370 Conveyor belt splices
- 15380 Conveyor belt vulcanizing equipment and material

- 15390 Grippers and tongs
- 15400 Handling machines
- 15410 Lifting clamps, safety lifting clamps
- 15420 Industrial robots, metallurgical, sensor controlled
- 15430 Chains
- 15431 Sprockets
- 15440 Tipping eyes, tipping shackles
- 15450 Crane wheels
- 15455 Crane ropes
- 15460 Storage yard equipment
- 15470 Laser distance measuring devices for cranes

- 15480 Load lifting belts
- 15490 Lifting magnets and equipment
- 15500 Magnetic brakes
- 15510 Magnets, magnet systems
- 15511 EGIS safety device for electric lifting magnets
- 15520 Wheels
- 15530 Corrosion, friction and wear protection
- 15540 Bulk containers
- 15550 Pulleys
- 15555 Safety device for electric load lifting magnets

- 15560 Separation magnets
- 15570 Silos for FF-masses
- 15580 Silos for bulk materials
- 15590 Handling plants for bulk materials
- 15600 Deflection rollers
- 15610 Packaging technology
- 15620 Wear protection coatings with aluminum oxide ceramics
- 15630 Wear protection coatings with rubber
- 15632 Wear protection technology
- 15635 Track-bound tippers
- 15640 Wagon tipper
- 15650 Hot transport and cooling hoods for steel ingots
- 15652 Weighing systems for steel production

19.11. Operating materials

- 15660 Lubricants

19.12. Packaging technology

- 15662 Automated packing stations for coils and long goods
- 15664 Packaging materials

20 Electrical engineering and automation

- 15670 Electromechanical actuators
- 15680 Engineering and technical assistance
- 15690 Technical translations and documentation

20.01. Electrical equipment for metallurgical plants and rolling mills

- 15700 Workplace design systems
- 15720 Three-phase motors
- 15730 Electrical equipment for metallurgical plants and rolling mills
- 15740 Electrical equipment for rolling mills
- 15750 Large electrical installations, complete
- 15760 Power supply systems for mobile consumers
- 15770 Spring cable reels
- 15780 Spring hose reels
- 15785 Radio remote controls
- 15788 Radio systems
- 15790 Radio control systems
- 15800 Gear motors
- 15810 DC motors
- 15820 High current cables and lines, water cooled
- 15830 Cables and wires
- 15840 Cables, cable reels and accessories
- 15850 Motorized cable reels
- 15860 Low voltage switchgears and installations
- 15870 Switchgears
- 15880 Slip ring bodies
- 15890 Fuse systems
- 15900 Heavy current capacitors
- 15910 Plugs and socket-outlets
- 15920 Power converters (frequency converters)
- 15930 Power supply systems (movable and also busbars)
- 15940 transformers (also for industrial furnaces)
- 15960 AC and intercom systems
- 15962 High voltage feeders and contacts

20.02. Control and automation systems

- 15967 Electrical, instrumentation and control engineering, general
- 15968 Installations for anisotropic control technology
- 15970 Automation, general
- 15980 Automation plants for ore and fine ore
- 15990 Automation plants for blast furnaces
- 16000 Automation plants for industrial furnaces, general
- 16010 Automation plants for cold rolling mills
- 16020 Automation plants for coking plants
- 16030 Automation systems for steel mills
- 16035 Automation systems for blast furnaces

- 16040 Automation systems for hot rolling mills and tube mills
- 16041 Automation systems for hot rolling mills
- 16050 Automation plants and process control systems in metallurgical plants and rolling mills
- 16055 Automation of strip processing lines
- 16060 Automatic detection systems
- 16063 Strip guiding systems
- 16070 Data transmission equipment and systems
- 16080 Industrial television technology
- 16090 Information and communication systems
- 16100 Identification
- 16110 Customized complete systems
- 16120 Guidance systems (inductive) for vehicles
- 16130 Control systems (by image processing) for vehicles
- 16140 Control and automation systems, general
- 16150 Positioning systems for cranes
- 16160 Process automation
- 16162 Process automation for strip processing lines
- 16170 Process automation for continuous steel casting plants
- 16180 Process automation for metallurgical plants
- 16190 Process control systems
- 16192 Process control with infrared detectors
- 16200 Process optimization
- 16202 Process optimization with weighing systems
- 16205 Shopfloor systems
- 16210 Control systems, complete
- 16220 Control stations for metallurgical and rolling mill plants
- 16230 Control systems, electrical
- 16240 Control systems, electronic
- 16250 Control systems for press water tanks
- 16260 Control systems, hydraulic
- 16270 Control systems, infrared
- 16280 Power supplies for automation and control
- 16290 Networking
- 16293 Video technology
- 16295 Weighing systems for process automation in steelworks

20.03. Data processing

- 16300 Analog devices and accessories
- 16305 Archiving
- 16310 Production and machine data acquisition BDE/MDE
- 16320 Data acquisition devices and systems
- 16330 Data processing
- 16338 Digital image processing
- 16340 Digital devices and accessories
- 16350 Expert systems
- 16355 Manufacturing Execution System (MES)
- 16360 Turnkey system solutions, hardware \ 057software
- 16380 X-Window Terminal

20.04. Software

- 16390 Simulation software
- 16393 Software for archiving, document management and workflow

- 16395 Software for order processing, warehouse and test certificate management
- 16400 Application software
- 16410 Software for slitting lines
- 16415 Enterprise resource planning system for metal and steel trade
- 16420 Software for production planning and control
- 16430 Software for statistical process control and quality assurance
- 16440 Technical calculation programs
- 20.05. Maintenance**
- 16450 Machine diagnostics
- 16460 Maintenance and inspection

21 Measuring and testing technique

- 16470 Gas measuring instruments for degreasing plants
- 16472 Gas measuring devices for metal degreasing plants
- 16480 Gas measuring devices for metal cleaning plants
- 16488 Multichannel measuring systems
- 21.01. Measuring and testing technology, general**
- 16490 Automation and metrology, color measurement
- 16500 Pressure transducers
- 16508 Corrosion testers
- 16510 Metrology
- 16511 Measuring magnetism
- 16520 Measuring and testing systems, general
- 16530 Measuring and testing systems, general
- 16540 Measurement value acquisition
- 16550 Measured value processing
- 16552 Measuring and test equipment identification labels
- 16553 Measuring equipment and test status identification labels
- 16560 Radioactivity warning systems
- 16564 Recorder systems, paperless
- 16566 Pre-warning of melt breakthroughs and residual wall thickness measurement on refractory linings
- 16568 Roll gauges
- 21.02. Measurement of physical properties**
- 16570 Distance measuring system
- 16580 Distance sensors for positioning and length measurement (laser, ultrasonic, optical, inductive and capacitive)
- 16581 Distance sensors for positioning and length measurement (magnetostrictive)
- 16590 Bath mirror measurement in converter
- 16600 Bath mirror control
- 16608 Strip thickness control (AGC)
- 16610 Strip sag measuring device
- 16612 Strip flatness measurement
- 16613 Strip flatness control
- 16615 Strip guiding system
- 16620 Tape tension measuring systems

- 16625 Tension measuring system for driven S-rolls
- 16630 Width measuring devices
- 16640 Strain gauges and measuring strips
- 16645 Strain measuring systems
- 16650 Strain and mass flow measuring systems
- 16652 Dressing degree and mass flow measuring systems
- 16660 Thickness measuring systems and devices
- 16670 Thickness gauges
- 16680 Distance switches and measuring devices (optical, acoustic and inductive)
- 16690 Torque measuring devices for S-rollers
- 16700 Torque measuring device
- 16710 Speed measuring devices
- 16720 Flow meters
- 16721 Flow measuring devices, capacitive, e.g. for coal injection
- 16730 Flow monitoring
- 16740 Diameter measurement
- 16750 Electrical measurement of mechanical quantities
- 16755 Electronic measuring system for hydraulic and lubricating oils
- 16770 Form measurement
- 16780 Level measuring devices
- 16790 Level control
- 16800 Level control
- 16810 Gas measuring instruments
- 16815 Oxygen sensors for waste gas
- 16820 Equipment and chemicals for waste water control
- 16830 Speed measuring devices
- 16850 Infrared switch
- 16860 Infrared radiation pyrometer
- 16861 Infrared radiation thermometer with scanner
- 16870 Infrared radiation pyrometer with scanner
- 16871 Infrared Radiation Thermometer
- 16875 Infrared thermography
- 16877 IR camera - infrared based slag detection
- 16878 Cameras, furnace cameras
- 16879 Cast iron temperature measurement
- 16880 Insulating capillary
- 16890 Force measuring devices for tension and compression
- 16891 Force measurement and weighing systems
- 16892 Force measuring systems
- 16900 Cooling water monitoring
- 16910 Length measuring devices for tubes
- 16920 Linear encoders
- 16930 Linear encoders (also for ways and distances)
- 16940 Linear encoders, ultrasonic (also for ways and distances)
- 16950 Length and speed measuring systems (optical)
- 16960 Laser speed and length measuring systems
- 16970 Conductivity and pH meters
- 16980 Mass flow meters
- 17000 Measurement of refractory linings (in operating condition)
- 17010 Measuring devices for electrical quantities
- 17020 Measuring machines

- 17030 Measurement printers
- 17033 Microstructure/roughness measurement
- 17035 Surface crack detection
- 17040 Opto-electronic measuring instruments
- 17050 Flatness measuring devices
- 17057 Profile measuring devices
- 17060 Profile measuring systems (non-contact)
- 17080 Pyrometer
- 17090 Pyrometer tubes
- 17100 Ratio pyrometer
- 17105 Inline concentration measurement of liquids
- 17110 Probes for liquid pig iron
- 17120 Tube measuring equipment
- 17130 Coating thickness gauges
- 17133 Coating thickness control
- 17135 Layer thickness control
- 17138 Slag detection with infrared
- 17140 Slag detectors
- 17160 Forging measurement
- 17180 Vibration measuring devices
- 17190 Rope testing equipment for round and flat steel ropes (rope belt conveyors)
- 17200 Dust measuring equipment
- 17210 Equipment for radiation measurements
- 17220 Systems for nuclear radiation measurement (input control)
- 17230 Immersion thermocouples
- 17250 Temperature measurement equipment
- 17255 Temperature profile measuring systems
- 17260 Thermocouples
- 17270 Thermocouple protection tubes
- 17274 Thermographic measurement
- 17280 Thermal conductivity measuring systems
- 17290 Rolling mill force measuring systems
- 17300 Rolling mill measuring systems
- 17310 Resistance thermometers
- 17320 Line scan cameras
- 17322 Non-destructive thickness measurement of refractory linings (during furnace shutdown)
- 17325 2-color pyrometer with fiber optics

21.03. Quality management

- 17340 3-D profile measurement of rails and other profiles
- 17341 3-D profile measurement of weld seams
- 17345 Pickling bath monitoring
- 17350 Breakdown early detection
- 17352 Breakdown early detection and monitoring
- 17360 Breakdown monitoring
- 17365 Chrome bath monitoring
- 17368 Roller emulsion control
- 17370 In-line surface inspection, optical
- 17380 Measuring instruments for quality management
- 17384 Mold control
- 17390 Length, speed and profile measuring systems
- 17400 Hole detection
- 17408 Surface inspection
- 17409 Surface inspection systems
- 17410 Surface inspection
- 17415 Surface inspection of strip steel
- 17426 On-line measurement of oils and waxes
- 17430 On-line surface inspection, optical
- 17432 On-line surface quality inspection, optical

- 17440 On-line roughness measurement
- 17445 Systems for quality data acquisition and processing

21.04. Quality control

- 17446 Strip edge inspection
- 17447 Strip steel surface inspection, automatic and complete
- 17448 Strip steel surface inspection, automatic and complete
- 17450 Quality control, visual
- 17460 Testing services

21.05. Services

- 17470 Metrology services

22 Materials testing

- 17473 Destructive and non-destructive materials testing

22.01. Non-destructive materials testing

- 17480 Consulting, execution, equipment
- 17490 Image processing, barcode readers
- 17500 Demagnetization equipment
- 17510 Internal pressure testing equipment
- 17520 Corrosion testing
- 17530 Measuring and testing machines
- 17536 Training and certification for NDT
- 17540 Ultrasonic testing equipment/machines
- 17560 Non-destructive testing of round and flat steel cables
- 17570 Non-destructive pipe testing equipment
- 17580 Non-destructive material testing equipment, general
- 17589 Non-destructive material testing equipment, acoustic
- 17590 Non-destructive material testing equipment, electromagnetic
- 17620 Non-destructive material testing equipment, optical
- 17630 Non-destructive materials testing with X-rays
- 17640 Non-destructive materials testing with acoustic emission analysis
- 17650 Non-destructive materials testing equipment with ultrasound
- 17660 Non-destructive materials testing
- 17664 Non-destructive materials testing with fluorescent and red/white penetrant methods
- 17665 Non-destructive material testing with fluorescent and red/white test method
- 17670 Non-destructive materials testing with coupling agent-free ultrasonic excitation
- 17680 Non-destructive materials testing, optoelectronic
- 17690 Non-destructive materials testing (service)

22.02. Strength testing, endurance testing

- 17698 Fixtures for tensile testing
- 17700 Stress analyses and reliability tests on machines and components
- 17710 Consulting, execution, equipment
- 17720 Fatigue testing machines

- 17730 Hardness testers
- 17740 Hardness testing equipment
- 17750 Machines for tensile test preparation
- 17760 Friction and wear testing machines
- 17770 Crack testing machines
- 17780 Pipe testing presses
- 17790 Torsion testing machines
- 17800 Universal testing machines for tension, compression, bending and tensile tests

22.03. Technological testing methods, testing service

- 17810 Chemical analyses
- 17820 Grain size analysis
- 17830 Mechanical-technological testing
- 17840 Metallographic testing
- 17850 Technological testing
- 17852 Technological testing, microscope image analysis
- 17860 Deep drawing testing machines for sheets and strips
- 17870 Conversion of conventional universal testing machines to electronic measurement with data processing
- 17880 Roll testing (concentricity, eccentricity)

22.04. Destructive material testing

- 17888 Corrosion testing
- 17890 Machines for the production of notched bar impact specimens

22.05. Fatigue testing

- 17896 Testing of safety valves in operating condition

22.06. Damage analysis

- 17898 Damage analysis

23 Analysis and laboratory equipment

- 17900 Engineering and technical assistance

23.01. Sampling and sample preparation

- 17910 Gas probes, gas sampling probes
- 17915 Sampling
- 17920 Sampling equipment
- 17940 Sample punching
- 17950 Sample transport
- 17960 Sample preparation
- 17970 Sample preparation for X-ray fluorescence analysis
- 17980 Sample preparation for OES and XRF (X-ray testing)
- 17990 Sample preparation machines
- 18000 Spectrometer sample preparation with remelting equipment
- 18010 Punching tools for samples

23.02. Analytical equipment

- 18020 Analytical instruments
- 18022 Devices for inline concentration measurement of liquids
- 18025 Analyzers for oxygen measurement

- 18027 Automated analyzers for process control and wastewater management
- 18030 Automation equipment for analysis and laboratory
- 18040 Gas analyzers
- 18048 Laser induced fluorescence
- 18050 Laser plasma spectrometer
- 18059 Mass spectrometers
- 18060 Conductivity and pH measuring instruments
- 18070 Oil-in-water monitoring in the laboratory and in industry
- 18080 Optical emission spectrometers
- 18090 O2 analyzers
- 18100 Plasma spectrometers
- 18105 X-ray diffractometers
- 18110 X-ray fluorescence spectrometer
- 18120 X-ray fluorescence spectrometers, portable
- 18130 Oxygen probes
- 18138 Heavy metal analysis in water, laboratory, field, process and online
- 18140 Nitrogen analyzer system for direct determination
- 18150 Nitrogen probes
- 18160 Hydrogen analysis system for direct determination
- 18170 Hydrogen probes
- 18180 Accessories for analytical technology

23.03. Laboratory equipment, general

- 18190 Analytical standards
- 18200 Analytical reference material
- 18202 Equipment for sample preparation for OES and XRF (X-ray testing)
- 18210 Calibration samples
- 18220 Annealing boxes
- 18230 Laboratory furnaces
- 18240 Laboratory equipment
- 18250 Laboratory automation
- 18260 Shuttles
- 18264 Shuttles and HF crucibles for C+S determination
- 18270 Spectral samples
- 18280 Crucibles

23.04. Metallography

- 18290 Services
- 18300 Metallography equipment
- 18310 Metallographic laboratories
- 18320 Metallographic testing

24 Environmental protection and disposal

- 18330 Consulting and measurement
- 18340 Engineering and technical assistance

24.01. Dedusting and gas cleaning

- 18342 Exhaust gas technology
- 18348 Oxygen sensors for exhaust gas
- 18350 Exhaust systems
- 18360 Exhaust gas cooling systems
- 18362 Exhaust gas cooling with heat recovery
- 18370 Exhaust gas cleaning systems

- 18375 Secondary exhaust gas cleaning systems
- 18376 Sintered exhaust gas cleaning systems
- 18377 Desulfurization of sinter flue gases
- 18378 Exhaust gas cleaning for pellet plants
- 18380 Waste heat boiler
- 18390 Aerosol separation
- 18400 Treatment of dusts from steel mills and foundries
- 18410 Electrostatic precipitator
- 18420 Dedusting and gas cleaning
- 18430 Dedusting plants and accessories, general
- 18440 Dedusting filters and plants (cassette, cartridge, round, bag, pocket filters, etc.)
- 18450 Denitrification plants
- 18460 Denitrification catalysts (DENOX)
- 18470 Fine dust removal for sinter plants
- 18480 Filter media
- 18490 Gas recovery plants
- 18500 Fabric filters
- 18510 Casting shop dedusting
- 18515 Blast furnace exhaust gas cleaning
- 18520 Hot gas filtration
- 18530 Industrial vacuum cleaners
- 18535 Catalytic plants
- 18536 Catalyst service
- 18540 Compact air cleaner
- 18550 Laser Clean Box
- 18560 Air filters (also in-line filters)
- 18570 Multicyclones and cyclones
- 18580 Afterburning, catalytic
- 18590 Afterburning, thermal
- 18600 Wet dust collectors
- 18608 Wet dedusting systems
- 18610 Wet fine dust removal for sinter plants
- 18615 Wet electrostatic precipitators
- 18620 Wet cleaning plants
- 18630 Flue gas desulfurization for boiler and sinter plants
- 18640 Flue gas cleaning plants for waste and hazardous waste incinerators
- 18650 Dust collectors
- 18660 Dust measuring devices
- 18670 Dust recovery plants
- 18690 Thermal exhaust air purification
- 18693 Dry exhaust gas cleaning plants
- 18700 Dry dedusting plants (also rotary flow dedusters)
- 18710 Dry cleaning plants
- 18720 Venturi dust collectors
- 18728 Central exhaust systems
- 18730 Central dust extraction plants

24.02. Waste water treatment

- 18740 Waste water plants, grease separators, chemical pumps
- 18750 Waste water treatment
- 18755 Waste water treatment, thermal
- 18756 Wastewater treatment for wastewater containing oil and grease
- 18760 Wastewater treatment plants
- 18770 Chemical water treatment
- 18774 Evaporation plants
- 18790 Wastewater treatment plants
- 18800 Recirculation systems
- 18802 Recirculating water treatment
- 18810 Solvent recovery plants
- 18820 Neutralization and detoxification plants

- 18830 Sludge dewatering, mobile
- 18840 Sludge dewatering, stationary
- 18842 Water management

24.03. Regeneration plants

- 18870 Regeneration plants for pickling solutions
- 18880 Acid resistant collection cups and wall coatings with DIBt test mark
- 18890 Sand regeneration plants

24.04. Recycling and waste disposal

- 18900 Exhaust air purification
- 18910 Remediation of contaminated sites
- 18920 Plants for the recycling of raw materials (dusts)
- 18921 Plants for the recycling of residual materials
- 18922 Car recycling plants
- 18923 Electric arc dust recycling
- 18925 Biological exhaust air treatment
- 18930 Soil and groundwater remediation
- 18940 Flaring plants, thermal afterburning
- 18970 Injection plants for filter dust
- 18975 Injection plants for alloy and residual materials using oxygen burners
- 18980 Storage of substances hazardous to water
- 18990 Oil and grease removers
- 18997 Radioactive substances
- 19000 Residue-free vibratory grinding
- 19005 Slag processing (slag transport and recycling)
- 19009 Chimney construction
- 19010 Chimneys (also sheet metal chimneys)
- 19020 Separation of non-ferrous metals
- 19045 Plants for preparation and recycling of metallurgical residues
- 19050 Other disposal plants
- 19060 Recycling of residual materials (ashes, slags, dusts, sands)
- 19070 Rolling mill slag de-zincification
- 19072 Dezincification of metallurgical dusts
- 19080 Recovery of recyclable materials
- 19090 Fluidized-bed drying of steel mill sludges

24.05. Components

- 19110 Separators (gasoline, benzene, oil, water)
- 19114 Aerators and agitators
- 19120 Emulsion splitting plants
- 19130 Injection plants for processed, oil-containing mill scale sludges
- 19140 Injection plants for Carbo Fer
- 19150 Injection plants for PE granules
- 19160 Heat exchangers

24.06. Operating materials

- 19170 Activated carbon
- 19180 Lignite coke
- 19190 Oil binder
- 19200 Lubricants

24.07. Services

- 19210 Exhaust gas measurements
- 19220 Chemical and mineralogical analysis
- 19230 Emission measurements
- 19232 Simulation software for exhaust gas measurement with design and optimization of exhaust systems

25 Occupational safety and ergonomics

- 25.01. Occupational safety**
- 19240 Occupational safety clothing
- 19260 Respiratory protection masks
- 19263 Fire blankets for welding work made of textile fabric
- 19266 Fire blankets and containers
- 19270 Gas detectors
- 19280 Heat protective clothing
- 19285 High temperature resistant and fireproof textile products
- 19289 Protective glass
- 19290 Industrial protective glass
- 19300 Light curtains for accident prevention and other applications
- 19305 Soldering protection mats made of textile fabric
- 19310 Furnace sight glass Neotherm®
- 19320 Safety edges
- 19330 Safety mats
- 19340 Welding protection glass Athermal®
- 19350 Welding accessories
- 19360 Dust measuring devices

- 25.02. Noise protection devices**
- 19368 Hearing protection
- 19370 Noise reduction
- 19380 Industrial noise protection
- 19390 Noise protection devices
- 19400 Noise monitoring
- 19410 Level recorder
- 19420 Sound insulation
- 19430 Sound level meter
- 19432 Sound insulation

26 Other products

- 19440 Aluminium and zinc slug production

- 26.01. Foundry products**
- 19450 Stainless steel mold casting
- 19460 Stainless steel shell mold casting
- 19470 Stainless steel centrifugal casting
- 19490 Investment casting by the lost wax process
- 19500 Cast iron with spheroidal graphite (ductile iron)
- 19510 Cast iron with lamellar graphite (gray cast iron)
- 19520 Cast iron shape casting
- 19530 Continuous cast iron
- 19540 Chilled cast iron
- 19550 Heat resistant cast iron
- 19560 Gravity die casting
- 19570 Copper and copper alloy castings
- 19580 Light metal castings
- 19590 Machine mold casting
- 19610 Acid resistant castings
- 19630 Centrifugal casting
- 19640 Heavy metal casting
- 19660 Steel casting
- 19670 Wear-resistant casting

27 Consulting, planning and services

- 19695 Hot tapping under pressure
- 19700 Fittings service
- 19710 Training and further education of welding personnel
- 19715 Consulting, planning and services
- 19720 Consulting services
- 19721 Consulting for optimization of weighing systems
- 19730 Consulting service
- 19731 Procurement, eProcurement
- 19734 blended learning
- 19740 Services, quality assurance
- 19750 Emission measurements
- 19760 Energy consulting
- 19770 Energy saving
- 19780 Energy service (optimization, recovery, supply)
- 19790 Decoating
- 19792 Spare parts for commissioning
- 19794 Commissioning
- 19810 Engineering services (also commissioning of metallurgical plants as well as conveyor and drive technology plants)
- 19815 Engineering problem solving
- 19820 Maintenance organization
- 19822 Cooling and boiler water treatment
- 19824 Lean management
- 19825 Leak sealing under operating pressure
- 19830 Logistics consulting
- 19832 Logistics services, steel logistics
- 19840 Contract annealing
- 19850 Contract annealing (own mobile annealing facilities)
- 19860 Management consulting
- 19875 On-site machining (milling, drilling, turning, grinding, etc.)
- 19880 Assembly and maintenance
- 19890 Marketing services
- 19892 Offline Maintenance
- 19893 Online Maintenance
- 19895 Quality management consulting
- 19900 Experts
- 19910 Cutting and welding consulting
- 19920 Welding research and education
- 19930 Simulation studies and software
- 19935 Software for metalworking
- 19940 Supplier of spare parts, equipment and accessories for the steel industry, general
- 19950 Radiation
- 19952 Radiation protection
- 19955 supply chain management
- 19960 Digitalization consulting
- 19970 Software solutions for digitalization
- 19980 Digitization analysis
- 19990 Technical translations and documentation
- 20000 Training and commissioning of metallurgical plants
- 20005 Management consulting
- 20010 Leasing of electronic measuring equipment, data technology and computers
- 20015 Continuing education
- 20016 Continuing education - refractory
- 20020 Certifications

28 Steel in civil engineering

- 28.01. Software for building and construction**
- 20050 Cad software

- 28.02. Steel in building construction**
- 20058 Structural steel
- 20070 Hall gates
- 20086 Pipelines

- 28.03. Steel in civil engineering**
- 20100 Offshore technology
- 20106 Tubes
- 20108 Micropiles
- 20110 Anchorages
- 20112 Sheet piling

30 Service concerning steel materials

- 20135 Processing services


- 30.01. Joining**
- 20178 Soldering

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STEEL TECHNOLOGY

A new generation of iron ore pellets for direct reduction

To prepare for the transition to direct reduction technology, the R&D department of Tata Steel Netherlands is working on receipts for innovative pellets optimised for the direct reduction process, among other things. One way to improve pellet characteristics is to optimise the grinding of the iron ore and the roasting parameters of the pellets. The influence of iron ore grinding on pellet quality was investigated in the 70-kg pilot pellet plant in IJmuiden.

ECONOMY

Paving the way for sponge iron on the railways

The steel industry has traditionally been closely linked to the railways. But what do the solutions of the future look like? VTG is working on this and presented the current status on a tour of Europe. An interview with Torben Jaeger, Managing Director and Head of Asset Segment Bulk, about cooperation with steel companies and flexible solutions for transport.

COMPANIES

Start of construction for voestalpine greentec steel

The traditional ground-breaking ceremony for greentec steel at the group's headquarters in Linz has taken place. This happened only a few weeks after the official start of construction work at the voestalpine site in Donawitz. As the first step of the phased plan, one electric arc furnace will be built at each of the two sites. With a saving of almost 4 million tonnes of CO₂ per year or 5% of the country's emissions, greentec steel is the largest climate protection programme in Austria.

STEEL DISTRIBUTION

European cooperation of steel distributors

Under the name astedis (association of steel distributors), five steel purchasing groups have started to cooperate in a European network as of 1 September 2023. The founding partners of astedis include the steel purchasing companies Coalsider from Spain, the purchasing group European Steel Group in Poland, the German purchasing association Nordwest, Sider Center from Italy and Socoda from France.

Place your ad in the next issue before **10 October 2023**
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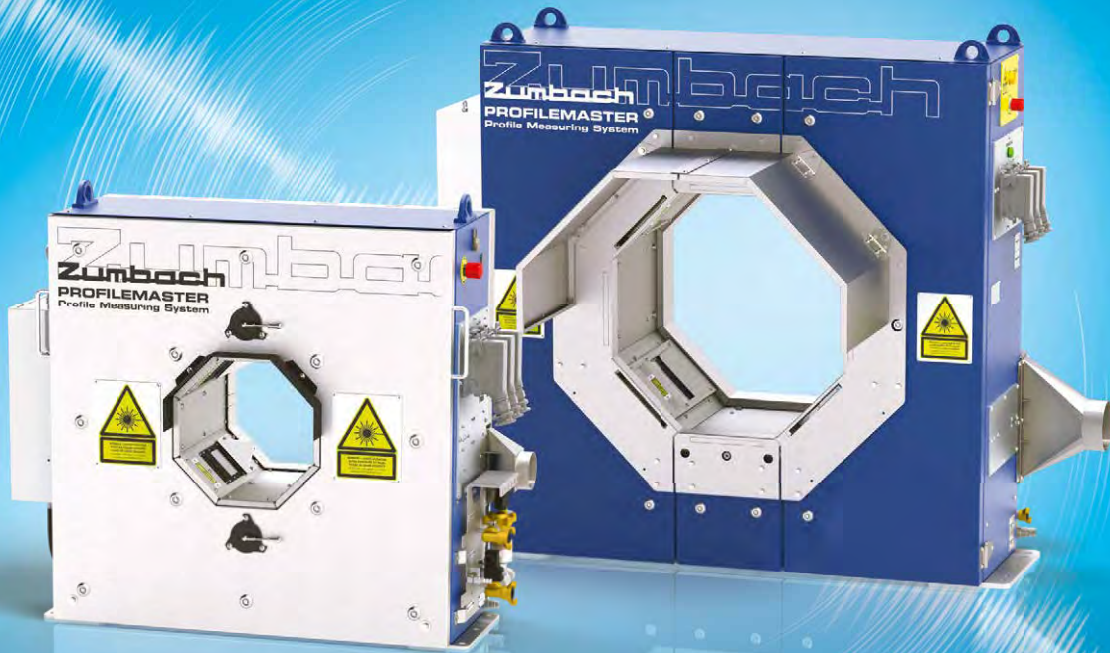
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