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STEEL+ TECHNOLOGY

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Looking for solutions, not soapbox speeches

Arnt Hannewald, Dipl.Ing.
Editor

These days, energy-intensive steel companies are being hit hard by skyrocketing energy prices. Short-time work and temporarily closed plants whose production has become unprofitable due to excessive running costs are not isolated cases. However, in the EU the conversion of the steel companies – particularly the integrated iron and steel works – to more climate-friendly production – the so-called Green Transformation – is making progress. In this issue we report on no less than three projects (in Germany and the Netherlands) that are now actually tackling the move away from coke-fuelled blast furnaces with very specific investments. In view of the energy crisis, disrupted supply chains and the war in Ukraine, the courage to decide on such a dramatic technological change is remarkable. The fact that the investment decisions have now been taken illustrates the determination with which the companies are taking their responsibility to reduce CO_2 emissions. It also shows that the established players in the steel industry have recognised the challenge suddenly posed by new players such as H_2 Green Steel (Sweden) or, more recently, Gravit Hy (France). These billion-dollar start-ups are apparently succeeding in mobilising a gigantic investment volume on the financial market. At the same time, they are recruiting industrial expertise that investors trust to build climate-friendly steel production on a greenfield site.

The steel companies have developed very different projects to decarbonise their operations and are now taking very individual paths to achieve the goal of "net zero". To provide you with an objective overview of the current state of the art, I spoke with Rolando Paolone, CEO and CTO of Danieli, one of the most renowned manufacturers of metallurgical plants. His conclusion is: "Competitive OpEx today means Green Metal technologies." He gives very detailed answers to the pressing questions in this time full of change.

Finally, a note on a special event: This year, the HÜTTENTAG steel conference and exhibition will take place on 17 and 18 November in Essen, Germany. The organisers have once again put together a top-class programme that will span two days for the first time. It is by far the most important not-to-be-missed event for steel professionals.

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Fossil-free steel producion of the future

Steel technology

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DANIELI GREEN METAL

Appointment of Martina Merz as CEO of thyssenkrupp extended

The supervisory board of thyssenkrupp AG has resolved to extend the existing executive board contract of Martina Merz by a further five years until March 31, 2028. Prof. Dr. Siegfried Russwurm, chairman of the supervisory board of thyssenkrupp AG thanked Martina Merz for her resolute approach to the transformation of thyssenkrupp and her agreement to continue to drive forward this change process in her role as chair of the executive board of the company.

Martina Merz, CEO of thyssenkrupp AG
(Photo: thyssenkrupp)

thyssenkrupp

Primetals Technologies launches new green steel task force

Primetals Technologies has launched a new task force to lead the green steel transition and appointed Dr. Alexander Fleischanderl as the head of the new organization. Primetals Technologies has set up the new task force to gather and refine the information and expertise within the company and support the implementation of Primetals Technologies' initiatives within the areas of green steel and energy transition. The portfolio covers the entire iron and steel production chain: upstream, downstream, metallurgical services, and electrics and automation. The green steel organization consists of a team of handpicked leading experts from all major locations of Primetals Technologies. The team will work together to lead and push the efforts on green steel, while actively developing synergies within Primetals Technologies as well as within the larger Mitsubishi Heavy Industries Group, which Primetals Technologies is part of.

Primetals Technologies

Dr. Alexander Fleischanderl heads the new green steel task force
(Photo: Primetals Technologies)

ArcelorMittal appoints new executive vice president and global head of HR

Stephanie Werner-Dietz has joined ArcelorMittal as Executive Vice President and global head of human resources, succeeding Bart Wille, who has decided to retire at the end of this year following a career of 37 years in human resources management.

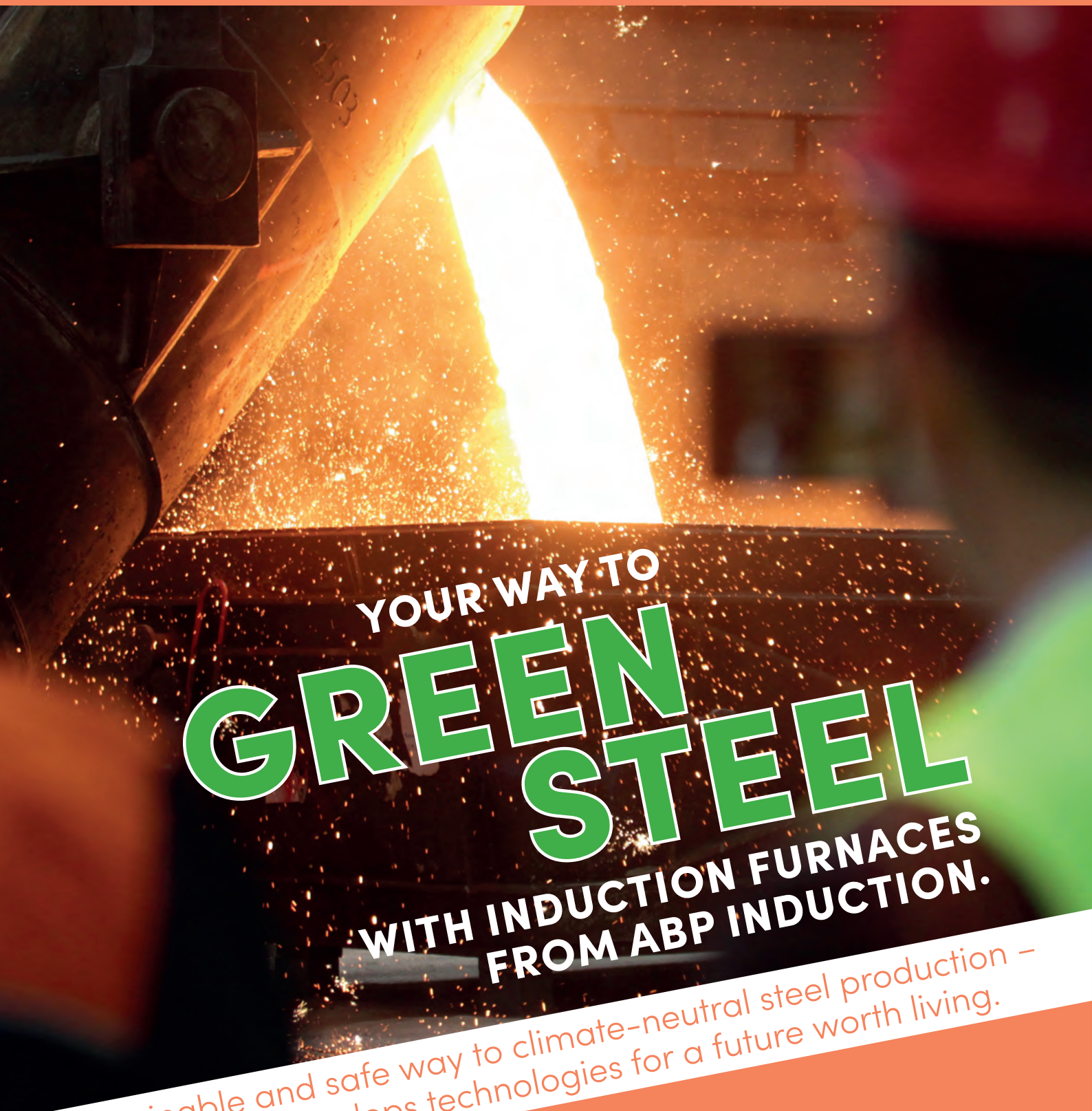
Stephanie Werner-Dietz joined ArcelorMittal from Nokia, where she was Chief People Officer and a member of the Group Leadership Team. In this position she had responsibility for all people-related topics including human resource management, real estate, and health and safety. She joined Nokia in 1998 after graduating from university, and in nearly 25 years with the company she held various HR leadership positions in Germany, Finland, China, Switzerland, the Philippines, the US and Romania.

ArcelorMittal

Stefan Kaufmann joins thyssenkrupp as hydrogen adviser

Dr. Stefan Kaufmann will serve as an adviser to thyssenkrupp regarding all cross-business hydrogen activities and projects. Stefan Kaufmann is a former Innovation Commissioner for Green Hydrogen of the German government. He will represent the company nationally and internationally in all matters related to hydrogen. Martina Merz, the CEO of thyssenkrupp AG, said: "In Dr. Stefan Kaufmann, we have recruited a highly respected hydrogen expert. We are certain that his exceptional experience and knowledge will move us forward throughout the entire value chain – in terms of demand, supply and infrastructure."

thyssenkrupp



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GERMANY

thyssenkrupp orders spindles for hot-strip mill

thyssenkrupp Steel Europe has selected Danieli to supply, install and commission new heavy-duty, slipper-type spindles for the No. 1 hot-strip rolling mill at its Bruckhausen plant in Duisburg.

The order consists of a complete new set of air/oil lubricated, slipper-type spindles along with all necessary equipment and spares to replace the current spindles in operation in the hot-strip mill. The new DanJoint spindles will be designed to suit new thyssenkrupp rolling parameters and facilitate the replacement of the existing spindles, minimizing shut-down time. The spindles will feature a torque & temperature monitoring system for real-time condition analysis.

The spindles will be manufactured at Danieli workshops in Italy and put in service within just eight months from the order.

Slipper-type spindles for installation in a hot-strip mill (Photo: Danieli)

Danieli

Elbe-Stahlwerke Feralpi orders long-product rolling mill

ESF Elbe-Stahlwerke Feralpi has chosen Danieli technologies for its new rolling mill for spooled bars to be installed at Riesa.

The new mill will be connected directly to the existing continuous caster by a 300-m hot-charge roller table that uses induction heating to avoid direct CO_2 emissions. For endless rolling, an in-line billet welder will be installed. The mill will comprise 16 housingless rolling stands, a six-pass, multidrive finishing block and a spooler line. The K-Spooler will produce spooled coils of 8 to 25 mm bars with maximum coil weights of 8 t. Danieli Automation will implement real-time connection between the existing caster and the new mill, dynamically regulating the thermo-mechanical process for the best final product quality. The new mill is scheduled to be started up by the second quarter of 2024.

AI package for melt shop operations

ESF Elbe-Stahlwerke Feralpi has contracted Smart Steel Technologies to implement the SST Temperature AI package at its production site in Riesa. The AI-based process control system will be installed at the melt shop, covering all processes from the electric arc furnace through secondary metallurgy to the continuous caster. Complementing existing process control software, the AI-based system provides real-time temperature predictions and real-time guidance for operators at all stations of the melt shop. As a result, temperature variances are minimized, process stability increases, and temperature buffers can be reduced. This enables the melt shop to reduce overall temperature levels in production, leading to energy savings and higher productivity.

Danieli/ Smart Steel Technologies

bp and thyssenkrupp Steel partner to advance decarbonization of steel production

bp and thyssenkrupp Steel have signed a memorandum of understanding (MoU) focused on the development of long-term supply of low-carbon hydrogen and renewable power in steel production.

thyssenkrupp Steel accounts for 2.5% of CO_2 emissions in Germany, mainly at the Duisburg site where the main emitters, the blast furnaces, are operated. By replacing the coal-fired blast furnaces with direct reduction plants where iron ore is reduced with low-carbon hydrogen, thyssenkrupp Steel intends to make steel production climate-neutral in the long term.

The companies will explore supply options for both blue and green hydrogen, as well as power from wind and solar generation through the use of power purchase agreements. thyssenkrupp Steel has the ambition to make its steel production climate-neutral by 2045 and low-carbon power and hydrogen will play a critical role in achieving this. bp is already investing in and working to develop a portfolio of industrial-scale hydrogen projects in Germany, the Netherlands, Spain, the UK and Australia.

thyssenkrupp Steel/bp

CZECH REPUBLIC

Liberty to build new hybrid electric arc furnaces

Liberty has signed a contract with Danieli for the delivery of two state-of-the-art hybrid electric arc furnaces. This is considered an important step forward in Liberty Ostrava's plan to become carbon neutral by 2030.

The two 200-t Danieli Digimelters will have a combined capacity of 3.2 million t/year and use the patented Danieli Q-ONE power electronics technology to control arc current and voltage for a more efficient and stable power supply to the furnaces. This will allow the furnaces to be more flexible in the charge mix from large quantities of hot metal and direct reduced iron (DRI/HBI) and up to 100% scrap in the second phase of the project. In the initial phase, the two Digimelters will replace Ostrava's existing four tandem oxygen converters and perform decarburization with flexible inputs of hot metal and scrap charges.

The new furnaces are expected to be operational in 2025 and will be able to melt 100% scrap in 2027, following the planned installation of a 400 kV electricity line into the Ostrava steelworks.

Danieli

FINLAND

Outokumpu's Kemi mine to reach carbon neutrality by 2025

Outokumpu has established a roadmap to achieve carbon neutrality at its Kemi chrome mine by 2025. The roadmap includes several initiatives that will decrease the mine's emissions towards zero.

Carbon neutrality of the Kemi Mine is an important step in achieving Outokumpu's ambitious climate targets. To reach carbon neutrality, Outokumpu has reviewed all emissions from the mine and established a carbon neutrality roadmap to minimize emissions towards zero by 2025. The three main factors are the utilization of carbon free electricity, using biofuels in transportation and machinery as well as replacing natural gas and propane gas with biogas in heating. Mining machinery electrification will also be extended to reduce the need for fuels.

Outokumpu's Kemi Mine is the only mine in the EU to produce chrome. Chrome from the Kemi Mine is transported to Outokumpu's nearby ferrochrome plant in Tornio.

Outokumpu

Outokumpu to delay restart of ferrochrome furnace

Due to exceptionally high energy prices and an unstable energy market, stainless steel producer Outokumpu has decided to delay the restart of one of its three ferrochrome furnaces after a planned maintenance break.

The maintenance break started on September 7 and restart was initially planned for week 40. Ferrochrome production will continue at about 70% of its full capacity. Ferrochrome production uses more than 50% of Outokumpu's total electricity consumption in Finland. Despite the decrease in Outokumpu's ferrochrome production, the company's stainless steel production will remain at the same level as stated in the January-June interim report.

Outokumpu

FINLAND

Outokumpu divests majority of its Long Products business to Marcegaglia

Focussing on its core business of flat stainless steel products, Outokumpu has signed an agreement to divest the majority of its Long Products business operations to Marcegaglia Steel Group.

"This divestment marks the accomplishment of the turnaround program for the Long Products business in the past two years. With Marcegaglia, we have found a responsible and committed owner to develop Long Products business even further. The sale is a natural step for Outokumpu in line with our strategy to focus on our core business, stainless steel flat products," says Heikki Malinen, President and CEO of Outokumpu. The transaction will be carried out as a share sale. It includes Long Products' melting, rod and bar operations in Sheffield, UK; bar operations in Richburg, US; and the wire rod mill in Fagersta, Sweden. The transaction does not include Outokumpu Long Products AB operations in Degerfors and Storfors, Sweden.

Corporate strategy ahead of time

Outokumpu has successfully completed the first phase of its corporate strategy with a strong focus on de-risking the company and strengthening the balance sheet.

The first phase of the three-phase strategy focused on three key priorities: commercial excellence, cost and capital discipline, and lean and agile organization. The company has made significant progress in all areas and strategy execution has proceeded ahead of plans. Outokumpu has already achieved both its financial targets, EUR 250 million EBITDA run-rate improvement and net debt to EBITDA ratio to below 3.0. Strong performance and diligent strategy execution in the first phase provide a solid foundation for the second phase until 2025.

While in the first phase of the strategy the aim was to de-risk the company, the second phase will be about strengthening its core. To achieve this, Outokumpu has launched two customer differentiated strategies for business area Europe: strengthening cost leadership in high-volume stainless steel products and achieving a global market leadership in advanced products. In business area Americas, the focus will be on sustaining the high profitability levels.

Outokumpu, Marcegaglia

SSAB supports university research program

Research team at the University of Oulu (Photo: SSAB)

SSAB Europe is contributing to the University of Oulu's ongoing fundraising campaign with a EUR 100,000 donation for research in technical sciences.

SSAB and the University of Oulu have had close cooperation since the 1980s and SSAB is currently one of the university's key partners. Cooperation aims at developing strategic competence in the Finnish metal industry. "Oulu is home to multidisciplinary competence that our industry can benefit from. Fossil-free steel is SSAB's number one development target. Digitalization, process metallurgy and steel processing technology as well as maintenance and other business expertise, together with steelmaking and production technology are important areas of competence for us," says Sakari Kallo, CTO at SSAB Europe.

SSAB

POLAND

ArcelorMittal invests in research and development program for premium rails

High-speed rail producer ArcelorMittal has selected Danieli technology for its research and development project focusing on the manufacturing of premium quality rails in Poland in Dąbrowa Górnicza.

The project, co-financed by the European Regional Development Fund, will make it possible to deliver head-hardened rails according to the latest European and American standards, in an efficient and environmentally friendly way. The new rail head hardening system will heat-treat hot rails of over 120 m length and mass per meter between 45 and 68 kg/m coming from the rolling mill to achieve hardness levels greater than 400 HB.

The selected, Danieli-patented, technology involves immersing rails in a non-toxic water-polymer solution and an effective and flexible cooling treatment that achieves homogeneous mechanical properties over the entire rail length. The system is energy-saving since no air blowers are used for quenching and no additional heating devices are required for head/tail temperature equalization. Danieli will be responsible for the supply of the innovative pilot installation, including utilities and services.

Danieli

Cognor upgrades EAF melt shop and bar and section mill

Danieli has received three orders from Cognor: For its Stalowa Wola facilities, Cognor ordered Danieli Automation's Q-One technology to replace the existing transformer serving its 48-t EAF, and a new spooler line and light section mill for its Krakow facilities.

Cognor will use the Q-One digital power feeder to improve the operational costs of its electric arc furnace. While offering high performance, the system achieves shorter power-on times, resulting in increased productivity, and less electricity and electrode consumption. The new system is scheduled to become operational in the summer of 2023.

The new spooler line will be installed downstream the existing Cognor bar mill in Krakow and produce 8 to 20 mm rebar-in-coil of up to 3.5 t weight at a speed of 75 t/h. It will consist of a 4-pass fast-finishing block, quenching-water cooling boxes and two coiling machines, including finishing services. Two new Danieli roughing stands will be placed between the existing reheating furnace and the rolling mill to enable feeding with 160-mm square billets.

The new light-section mill will produce a wide range of sections including flats, equal and unequal angles, beams, and tee, round and square sections. A new walking-beam reheating furnace will feed an 18-housingless-stand rolling mill with 160-mm square billets. Danieli will supply finishing facilities, including straightening and cut-to-length systems, and rolling guides for entire production mix. The spooler line is expected to start operation by the end of 2022. The light-section mill is intended to be operational by the end of 2023.

Danieli

FRANCE

ArcelorMittal continues pickling line upgrade

Upgraded entry section of the Mardyck pickling line (Photo: Danieli)

Danieli Service recently commissioned the new entry section of the continuous pickling line at ArcelorMittal's Mardyck facilities.

The equipment installed includes a pay-off reel, coil car, hold-down roll structure, flattener, shear, pinch roll, steel structures and roller tables. The upgrade enables operation with oval coils that give extra loads in the uncoiling phase, due to the oval coil inertia during rotation. The erection and commissioning activities, including cold tests, were performed while the rest of the original line was regularly in production. Danieli Service's project scope included the new equipment and advisory services from erection and commission to production start-up.

Danieli

ITALY

Marcegaglia completes revamping of hot-dip galvanizing line

Marcegaglia has completed the revamping of its No. 1 hot-dip galvanizing line in Ravenna. The project was implemented by Danieli Centro Combustion.

Marcegaglia invested in a hot-dip galvanizing line modernization (Photo: Danieli)

As requested by Marcegaglia, the turnkey revamping of the hot-dip galvanizing furnace was to be performed during a line outage of only fifty days. In fact, the pre-assembly strategy for the steel structures, furnace casing and piping, along with comprehensive pre-testing of the automation system, made it possible to save ten days of installation time. The project included revamping the horizontal direct-flame fired section, the pre-heating section and the after-pot cooling system. This, together with the installation of new burners fed by combustion air pre-heated by a new centralized recuperator in the waste gas duct achieved a significant production increase and a marked reduction of specific natural-gas and electricity consumption.

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SWEDEN

Hybrit initiative starts test phase for pilot hydrogen gas storage facility

At Svartöberget in Luleå, SSAB, LKAB and Vattenfall have inaugurated the Hybrit pilot facility for fossil-free hydrogen gas storage. The inauguration ceremony marks the start of a two-year test period.

The Hybrit initiative was launched in 2016 by SSAB, LKAB and Vattenfall. The hydrogen storage facility will play a very important role in the overall value chain for fossil-free iron and steel production. Producing fossil-free hydrogen gas when there is a lot of electricity, for example when it is very windy, and using stored hydrogen gas when the electricity system is under strain, will ensure a steady production of sponge iron, the raw material behind fossil-free steel.

The technology for storing gas in a lined rock cavern is well proven and has been used in southern Sweden for about 20 years for storing natural gas. Now the technology is taking a step forward by the development for storage of hydrogen gas. The pilot plant has a size of 100 m³. At a later stage, a full-scale hydrogen gas storage facility measuring 100,000 to 120,000 m³ may be required, in which case it will be able to store up to 100 GWh of electricity converted to hydrogen gas, which is sufficient to supply a full-sized sponge iron factory for three to four days.

Hybrit cavern for storage of fossil-free hydrogen gas (Photo: SSAB)

SSAB, LKAB and Vattenfall

H2 Green Steel partners with Hitachi Energy and Statkraft

Hitachi Energy joins forces with H2 Green Steel on projects that support the industrial start-up in producing green steel. With Norwegian Statkraft, H2 Green Steel has concluded a seven-year purchase agreement for renewable electricity for its operations in Boden, Sweden.

In a Memorandum of Understanding, Hitachi Energy and H2 Green Steel have outlined a collaboration with three main elements: an equity investment by Hitachi Energy in H2 Green Steel; products and services from Hitachi Energy that are needed to construct and improve the electrical infrastructure to power steel production and giga scale electrolyzer plants; and green steel off-take from H2 Green Steel for the manufacturing of Hitachi Energy's products, once production starts.

Starting with the plant in Boden, which will be home to an approximately 800 MW electrolyzer producing the green hydrogen needed to make green virgin iron for the steel production, H2 Green Steel will leverage Hitachi Energy's capabilities to optimize customers' value chain to plan, build, operate and maintain the power infrastructure, which includes IT and operational technology. As part of the agreement Hitachi Energy will also become a customer of H2 Green Steel at start of production, in addition to stepping in as an investor in the company.

In a power purchase agreement with Statkraft, H2 Green Steel has secured a long-term yearly supply of 2 TWh of renewable electricity produced in the period 2026-2032. The delivery includes guarantees of origin for renewable energy, sourced from Statkraft's hydropower plants in Northern Sweden. In the first phase, H2 Green Steel will produce 2.5 million t of green steel annually.

H2 Green Steel, Hitachi Energy, Statkraft

UNITED KINGDOM

Liberty reaches standstill agreement with Greensill Bank

Liberty Steel Group has entered into a Standstill Agreement with Greensill Bank, its largest creditor, on the debt facilities relating to its European steel businesses.

Under the agreement, all enforcement actions are paused between the parties over the Greensill Bank debt facilities provided to Liberty in 2019. The agreement shall enable Liberty to develop a longer-term sustainable financing structure. The agreement is valid until 31st October 2022 and may be extended until the end of 2022.

"We are working intensively towards a settlement with our major creditors in a timeframe which would obviate the need for a legal battle. Our core businesses continue to perform well and are operationally strong despite some economic headwinds," a Liberty Steel Group spokesperson said.

Liberty Steel Group

Tata Steel invests in tube mill facilities

Tata Steel is building a new cold tube mill at its Corby site and will install a new slitting line at its Hartlepool tube mill.

Cold tube mill at the Corby facilities (Photo: Tata Steel)

One of the four tube mills at Corby will be completely replaced with state-of-the-art technology leading to improved efficiency, reduced energy consumption and better availability for customers. The new mill will roll steel into tubes, which can be used in construction and various engineering applications from farm machinery to bridges and heavy goods vehicles, and is expected to be completed by the end of 2023.

The new slitter for the Hartlepool mill will allow the site to process coils of steel delivered from its Port Talbot steelmaking site, itself. Currently, wide steel slabs are slit in Port Talbot before being rolled and sent to Hartlepool to be turned into steel tubes.

Both projects will further strengthen Tata Steel's UK business, improving services to customers and using the latest available technology to reduce environmental emissions.

Tata Steel

Tata Steel upgrades continuous annealing line at Trostre

Tata Steel has upgraded the continuous annealing process line (CAPL) at its Trostre plant in Llanelli with a major investment in the latest technology. The key contractor for this project was Danieli.

The continuous annealing process line is used to soften the steel strips before they go on to be made into cans for food, pet-food, aerosols and paint. The investment has seen the complete replacement of all the drives with a state-of-the-art new system. Works Manager, Joe Gallacher, said: "This is one of the biggest single investments in Trostre in recent years and allows us to run the line faster and for longer, removing a key bottleneck at the plant."

Tata Steel

Next phase of the transformation process

Tata Steel begins initial preparations for future DRI and REF facilities at Dutch site

At the Ijmuiden site in the Netherlands, the international steel group will initially invest 65 million euros in the next phase of the hydrogen route and produce green steel here as soon as possible

Tata Steel Nederland has signed contracts with three companies – McDermott, Danieli and Hatch – for the further technical preparations of the hydrogen route in Ijmuiden in the Netherlands. Tata Steel wants to transfer to green steel manufacturing in a clean environment as fast as possible. All three companies have their own specific expertise that collectively is needed to help Tata Steel shape and deliver the hydrogen based steel manufacturing. The cost for this first development step are in excess of 65 million euros and will result in an engineering package that forms the basis for a final permitting and project planning.

The "Heracless" (Hydrogen era - carbon- less) project is arranged in five phases:

- design phase: up to and including summer 2022
- engineering phase: summer 2022 to early 2024
- construction preparation phase: 2022 to 2026
- construction phase: 2026 to 2028
- start-up phase: 2029

> "We have committed to being CO2 neutral before 2045 and emit between 35 to 40% less CO2 before 2030. This will primarily be achieved via the hydrogen route."
>
> *Hans van den Berg, CEO of Tata Steel Nederland*

The overall project is led by the Tata Steel internal project and sustainability team, in close support of the main delivery partners. McDermott is responsible for the construction input and support of the technical project management. Danieli is responsible for the engineering design for the plant and technology that delivers the Direct Reduced Iron (DRI), the 1st step in the iron making process. Hatch is the technology licensor of the reducing electric furnaces (REF) that melt the DRI and help to reduce the oxygen content further thereby improving the final steel quality.

Intended position for the first DRI-REF complex on the works site in Ijmuiden (Picture: Tata Steel)

Climate neutral before 2045

"We recently signed agreements about our future with two ministries and the province of North Holland. In doing so, we have committed to being CO_2 neutral before 2045 and emit between 35 to 40% less CO_2 before 2030. This will primarily be achieved via the hydrogen route where the blast furnaces are replaced with modern clean steel making technology that uses hydrogen or gas instead of coal", explains Hans van den Berg, CEO of Tata Steel Nederland.

A major reconstruction will take place in IJmuiden. "What we do is a complicated and unique operation," explains Annemarie Manger, sustainability director of Tata Steel Nederland. "The new plants will be built on our site while all the current plants will remain in operation until the new installations are up and running. That requires intense integration between facilities and close collaboration between all parties and our people. The coalition that is now formed with McDermott, Danieli and Hatch marks the start of the basic engineering to define our plans more specifically."

A lot happened in one year

The switch to green steel is the biggest change in the company's more than 100-year history. It is a technological tour de force with many deep consequences. In

the past year, a lot of hard work has been done in various areas to prepare for this transition. For example, Tata Steel has signed an agreement with the national grid operator TenneT for a direct connection to the national electricity grid in order to be able to use green energy in the future operations. The layout of the new facilities and the physical integration inside existing plant is especially challenging, and has strong impact on the project execution, the overall operational logistics and the environmental impact.

Talks have started with the unions and potential impacted employees about the change to ensure all employees are fully included. During the summer, the Tata Steel organized a first information event that was attended by over 80 companies and suppliers. These companies are typically part of the Tata Steel operations and take care of a large part of the operational maintenance on the site in IJmuiden. The early information and inclusiveness helps them to better assess the impact of the change. The Tata Steel Academy (the company's own training institute) has set to work to determine which competencies and qualifications the employees need and is developing new teaching modules. The Academy is also preparing lessons for secondary school students in the region by offering a practical module on how to make hydrogen.

This computer graphic already shows a later expansion stage with two DRI-REF production units (Picture: Tata Steel)

About the technologies

For the planned **direct reduction plant** Tata Steel has opted for Energiron®, a technology jointly developed by Danieli and Tenova. Direct reduction technology is a relatively new production method, in which iron ores are directly reduced using natural gas or hydrogen, rather than coal. Energiron® DRI plants are hydrogen-ready by design and can start using hydrogen as reduction gas without equipment modifications. The reduction of iron ores takes place in a DRI plant in a shaft reactor at a relatively low temperature of up to about 1000°C. DRI pellets processed by Energiron® plants allow up to 96% metallization and variable carbon-content ranging from 0.5% with extensive use of hydrogen, and up 4.5% using 100% natural gas.

The DRI plant and the **reducing electric furnace** (REF) are closely coupled to form an integrated production system. The REF is a large and efficient rectangular electric smelting furnaces where the DRI is melted and refined. During this step the right amount of carbon is being added to create a very precise and high quality feedstock for the subsequent steel plant.

Tata Steel has engaged Hatch to develop basic engineering for the DRI reduction smelting complex, and to design and supply the reducing electric furnaces and ancillary process equipment within the complex. The Hatch scope broadly includes feed mixing, hot mix transfer, primary and secondary off-gas systems, electric furnaces, and slag granulation.

The DRI-REF technology offers several advantages. By using green electricity and a predominant hydrogen stream, the CO_2 emissions from the process are much lower than when using blast furnaces. The new process can also accommodate higher percentages of circular steel, where scrap can be added to the REFs or the induction furnaces. In addition, production with DRI technology offers more operational flexibility, without compromising the high quality steel that IJmuiden is already known for.

Tata Steel/Hatch/Danieli

Transformation from blast furnaces to climate-friendly steelmaking technology

Salzgitter group takes next investment steps towards low-CO_2 steel production

First EAF is scheduled to commence in Salzgitter by end of 2025. In addition, the use of high-quality iron ore products for hydrogen-based direct reduction is to be examined

Following the decision by the Salzgitter AG supervisory board in July to approve capital funding in the amount of € 723 million for the SALCOS® (Salzgitter Low CO_2 Steelmaking) project, the first order has now been placed for central plant components that will enable virtually CO_2-free steel production in Salzgitter. In August 2022, the German steel producer signed a contract with Primetals Technologies for the engineering, supply and erection of the first electric arc furnace (EAF) and the development of the technical infrastructure in Salzgitter. Ulrich Grethe, Head of Steel Production at Salzgitter AG, commented: "This step underscores our ambition through SALCOS® to retain our leadership in decarbonizing the steel industry and ensure that our plant here in Salzgitter is securely positioned for a long-term future. With Primetals we have a strong partner by our side – true to our Salzgitter AG 2030 strategy and to the principle of partnering for circular solutions."

The goal of SALCOS® is, in three stages between now and 2033, to convert the integrated steelworks entirely to low-CO_2 crude steel production. As part of the transformation, **two direct reduction plants and three electric arc furnaces will be built** to successively replace the blast furnaces and converters. In this way the previous process based on coking coal will give way to a new water-based route to steelmaking. Anticipated savings are in the order of 95% of annual CO_2 emissions of around 8 million tonnes. That means that around 1% of Germany's emissions of CO_2 can be avoided.

Technical specifications of the new EAF plant

Primetals Technologies will supply an AC EAF Ultimate. With a tapping weight of 220 tons, the furnace will have an annual capacity of 1.9 million tons of steel. It will be capable of smelting sponge iron and steel scrap along with various additives in less than 50 minutes. The crude steel will then be refined using the existing steelmaking facilities, cast in slabs, rolled and processed.

EAF Ultimate is part of Primetals Technologies new generation of electric steelmaking equipment. It is characterized by short tap-to-tap times, fully automated operation, and advanced control systems. The Salzgitter EAF plant will feature a dust removal systems, a heat recovery system, a water management system, electrical compensation for grid stabilization and material handling for alloying materials and additives. It will also include Level 1 and 2 automation and the LiquiRob robot system.

The heat recovery system will convert much of the waste heat into steam which is then fed back and used in other production units. Part of an extensive digitalization package, the condition-monitoring system ALEX will identify potential incidents before they occur. The tailormade Lomas off-gas analysis system determines all relevant values of the off-gas composition to ensure higher availability, reduced energy consumption and increased safety measurements.

Plant assembly will commence at the end of 2024, once the technical infrastructure is in place. Production is slated to start at the end of 2025.

The EAF and the ancillary modules will be fitted with sound insulation in order to securely comply with the permissible noise limits at the workplace and in the neighbouring communities.

Use of high-quality iron ore products for hydrogen-based direct reduction to be examined

Salzgitter Group has agreed with major iron ore suppliers in two MoU – Memorandum of Understanding – to examine and expand processes and supply chains. **Rio Tinto** and the Salzgitter Group have agreed in an MoU to examine technical, logistical and grade-specific issues for low-carbon supply chains and green steel production processes. The focus will be on the future supply of high-quality iron ore products for the SALCOS® program. The technical issues comprise the following in detail: optimizing pellet quality with respect to direct reduction with hydrogen, the use of lump ore and other iron carriers when reducing by hydrogen, and the production of a sinter for deployment in a direct reduction plant when reducing by hydrogen. Furthermore, the carbon emissions in the entire supply chain and opportunities for their registration and certification are to be examined.

Also, the Swedish mining group **LKAB** and Salzgitter AG have forged a technical cooperation agreement. LKAB produces about 80 percent of the iron ore mined in the EU and provides steel companies with high-quality, low-carbon iron ore pellets and fines. It has already started to transition its production of iron ore to carbon-free sponge iron (HBI/DRI), a strategy aimed at enabling annual emissions savings of more than 40 million tons of CO_2 in the steel industry before 2050.

Very high-quality iron ore pellets are required for the new steelmaking process via SALCOS® involving direct reduction plants and electric arc furnaces. The planned technical cooperation entails LKAB and Salzgitter examining which prerequisites need to be created to achieve this and evaluating the potential development of iron-ore-based raw materials for the future steelmaking process route.

Salzgitter AG/Primetals Technologies/ LKAB/Rio Tinto

GSM 200 to capacity and GFM 100 to capacity
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in operation at Standard Steel, Burnham / PA

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GFM 150 to capacity
in operation at Scot Forge, Spring Grove / IL

Interview

Today, competitive OpEx means Green Metal technologies

A good talk with Rolando Paolone, CEO of Danieli and CTO of Danieli Group on the most advanced steel production processes

Rolando Paolone talking to Arnt Hannewald via the internet (Picture: Danieli)

With Danieli`s motto: Innov-Action to be a step ahead in CapEx and OpEx the group aims to inspire people to always put innovation into action to achieve even higher levels of quality and standards in every aspect of their work – from planning, designing and manufacturing to erection, commissioning and service. Rolando Paolone is by sure one of these passionate and inspired people, a leader who wants to build a stronger sustainable future. In this interview he talks about the latest technological developments and the contribution to the fossil-free transformation of the steel sector.

What are the important steps for the transformation of steelmaking – from high CO_2 emissions to eco-friendly production?

Rolando Paolone. Until now, more than 70% of the world steel production – in average – is done through the traditional route using BF/BOF – initially from iron ore that is reduced in the blast furnace using mainly coke. This production generates a large quantity of CO_2 emissions, from around 2,000 to 2,500 kg of CO_2 per ton of steel produced. This volume of emissions is very high, especially if compared with the steel production route starting from scrap – the EAF route– which generates only one fifth of that.

Back to the iron ore, there is a technical solution available to lower the GHG emissions: the direct reduction process, which uses a natural gas instead of carbon. In terms of emissions, this solution comes close to the EAF-process with scrap, and the emissions will be much less if hydrogen can be used for the direct reduction of the iron ore.

Why do steelmakers not simply use hydrogen instead of fossil fuels in their plants?

Rolando Paolone. There is a long discussion on hydrogen nowadays everywhere in the world. The main point regarding hydrogen is that a lot of electrical energy is required to produce hydrogen, mainly from water. The first issue is that a considerable amount of water is required to produce hydrogen. So, if somebody says we can produce electrical energy in an eco-friendly way using photovoltaic cells placed in the desert, we must also consider that water is missing there. In the electrolyser the water is actually consumed. This is not 'use and recycle' like in a water treatment plant. In the electrolyser water is split into hydrogen and oxygen. To get 1 kg of hydrogen we need 9 to 10 kg of water.

So, a lot of water and a lot of green energy is needed to produce hydrogen. And this is the second point: we need a lot of electrical energy. In some ways the desert areas are fantastic for producing electricity thanks to the solar energy available there. Concentrated solar power plants that use mirrors and incorporate thermal energy storage can produce electrical energy in desert regions with a high level of efficiency, much better than photovoltaic cells at any location, as per results achieved at Danieli FATA installation in Partsanna, Sicily.

But anyhow, we think that direct reduction plants using hydrogen will replace the BF/BOF integrated plants sooner or later. This is the route that the world should take.

There are of course difficulties. One is the amount of money to be invested. Because of course, if somebody has BF/BOF technology in place, they have a plant that maybe is quite old but is running well. And so, to change they need to invest a lot of money to substitute the blast furnace with direct reduction technology.

The other is the difficulty to leave a consolidated and certified BF/BOF route.

Would it be feasible to start with a small DRP unit first and increase the capacity step by step?

Rolando Paolone. The investment in direct reduction technology is significant.

Rolando Paolone became a member of the Executive Board of the Danieli Group in 2017
(Picture: Danieli)

In terms of cost – TCO and ROI – a small plant with an annual capacity lower than 1.2 million tonnes of DRI is not reasonable.

Does processing of DRI instead of hot metal affect downstream production?

Rolando Paolone. It really depends on the products and customers. With products for the construction sector, it is not an issue to go via DRP and electric arc furnace, ladle furnace and continuous caster, and then downstream to the rolling mill, and so on. But for people that are producing automotive steel it's different.

For integrated steel companies it may be more difficult to change their process routes because the original routes – including steel plants and rolling mills – have been certified, especially when working within the automotive sector. Even more than for the products, they need certification for their processes, to demonstrate that at all times the process will get the same result – in terms of material characteristics, etc. So, that means that these steel companies are not so happy, let's say, to change their process routes.

Let me add some words about the so-called exposed materials for automotive. While processing DRI may not be so disruptive in relation to the total steel production, it could be trouble for some of the big players.

While the big producers can dedicate one site to exposed automotive materials (via BF/BOF) and the remaining capacity to other products (via DRP and electrical arc furnace), the medium/small producers need to keep the BF/BOF route. Maybe an area with the running facilities (BF/BOF) can be dedicated to the production of just the exposed steel grades. Then, the eco-friendly route, (i.e. DRP, EAF, etc.) shall be implemented for the other products.

Going back to the base material: in terms of carbon footprint, it would be the best to use scrap. But there are two issues with the scrap: quality and availability. In most regions of Europe for instance, it will become difficult to build a new meltshop to be fed with scrap, because there is no additional scrap available in the region. That's why new capacities for DRI production are needed.

Do you think there is a chance to reduce CO_2 emissions immediately, before a completely new process chain will come on stream after a few years?

Rolando Paolone. There are several initial steps to go. First, it is also a good idea to increase the quantity of scrap charged into the BOF. A share of up to 30-35 per cent of scrap in the BOF charge is feasible. The charge mix changes to a minimum of hot metal required. Thus, the less iron ore has to be reduced, the less the CO_2 emissions there will be at the ironmaking site, as long as enough scrap is available.

Rolando Paolone, Danieli Group CEO and CTO

Rolando Paolone graduated as a mechanical technician at A. Malignani Technical High School, Udine, Italy in 1981. He has been in Danieli & C. since 1985, starting as a design engineer in the Long Product Hot Rolling Mills Division (Danieli Morgardshammar). In 2006 he was in charge of the Process & Technological Department for the Long Products division of which he was appointed Executive Vice President in 2008. In 2014, he became Danieli Research Center Executive Vice President. In 2017, he was promoted to Chief Technology Officer of the Danieli Group and became a member of the Group Executive Board. Promoted again in 2021, he became Group Chief Executive Officer while retaining the title of CTO.

Another option is to partially substitute hot metal with DRI. For example, if a company operates maybe four BFs, they stop one of them and use DRI to be melted in a primary melter – which is a simple EAF. The heat is then mixed in the BOF with the hot metal coming from the BF. Here it undergoes metallurgical treatment, before feeding the caster. This is a technology available now. Thus, if one of four BFs is replaced by a DRI plant, approximately 20 per cent of the total CO_2 emissions can be avoided, which is already a good first step.

Using the Danieli Digital Melter – Digimelter, which is an advanced electric arc furnace – together with the BOF, means that the downstream process route remains the same. That makes it easy to get the process chain certified, because the feeding of the caster and all other downstream technologies remain unchanged. So, they will have the certification of the product, and also the reliability of the process is easy to demonstrate and certify.

Using the Danieli Digital Melter, which is an advanced EAF, together with the BOF, means that the downstream process route remains the same (Picture: Danieli)

There is another big advantage of this solution, using an electric meltshop in addition to BF/BOF, which is the possibility to use the LF gradually, without the BOF. And there is the option to skip the BOF and instead sending the liquid steel from the EAF via ladle furnace directly to the caster. This can be done for certain products at first, without losing the BOF route completely.

So, it is one step in the direction of DRI in combination with gas. You can have the possibility to test your product too, and get your staff acquainted with a new process route and learning how to process this, and so on. So, it will be a smooth change from the traditional processes to the eco-friendly way. Even if this technology is proven already, it will be new to the staff. And so, this is also a good chance to start the transformation to eco-friendly production.

Will there continue to be a shortage of scrap in Europe?

Rolando Paolone. As long as European countries will continue exporting more goods containing steel than importing them, there will be more steel to be produced than recycled here. Consequently, there is a need to reduce use of iron ore as a base material, which will be reduced, but in future using direct reduction instead of BF/BOF plants. This substitution will start slowly, maybe it will take five years or more for the blast furnaces to be replaced by DR plants.

You mentioned the Danieli Digital Melter. What are the special features of this technology?

Rolando Paolone. At the electric arc furnace, again the aim is to reduce emissions, and there the electrical performance is the key. Our new solution Q-One greatly improves the management of the electric arc, which is no longer treated like in the old solution, i.e., to manage the arc by moving the electrodes up and down to have the best arc in the furnace.

Instead, the arc is managed with electronics. So, we are controlling the current in the electrodes without shifting them up and down. The power cables do not sway anymore, they are absolutely stable. Thanks to this fantastic energy control we save at least 10% of that energy.

And then we draw the same amount of energy or more from the electrodes because the life of the electrodes is longer.

Together, savings in energy consumption and in electrode consumption is in the range of 10 to 15%. Less consumption of electrodes also means less CO_2 emissions, which together with a new "sealed design" can cut the emissions approximately by half, such as 40 instead of 80 kg CO_2 per tonne of steel.

What other options are available to reduce the carbon footprint?

Rolando Paolone. We've developed many solutions that dramatically reduce CO_2 emissions and at the same time reduce operational costs of the scrap route. One perfect example is endless rolling of long products. In that case, we don't reheat the billets, which go directly from the caster to the rolling mill, saving 70 to 80 kg of CO_2 per ton of steel. This is another truly green solution because we practically avoid the NG-fuelled reheating furnace. Instead, we can use an electrical solution, i.e., an induction furnace to increase the billet temperature a little bit, just in case, because maybe the casting heat was not sufficient for rolling. The billet passes through a couple of coils, adjusting it to the required temperature. This has been a proven solution for long products for many years.

DUE – Danieli Universal Endless technology is now recognized an eco-friendly way to produce thin hot strip in the thickness range of 1.5 mm (Picture: Danieli)

Now we are developing a similar system for endless rolling of flat products, substituting a conventional NG reheating furnace with an electric one. It will be probably the new trend to try to avoid any flame as much as possible because flames – if produced by gas – mean CO_2 emission. Of course, if the flame is hydrogen there is no GHG emission, but I don't see enough green hydrogen supply to fuel furnaces in the near time, to be honest.

Has Danieli ever tried carbon-capture technologies?

Rolando Paolone. Yes, but honestly, that's not the optimal solution. First, carbon capture is extremely difficult at the BF and BOF due to the huge volume of fumes in the off gas, while especially at the BF it would be important to capture the CO_2. We have achieved better results for carbon capture at reheating furnaces.

But, at the end of the day, we prefer carbon direct avoidance by replacing the BF/BOF with a DRP/EAF (using green hydrogen) and eliminating the reheating furnace either by endless rolling technology, or by fast transfer to the rolling mill with a small induction furnace before the first rolling stand. These solutions reasonably reduce CO_2 emissions, and in most cases lower operational costs, too.

When do you think endless rolling technology will be available for flat products?

Rolando Paolone. We have already developed our DUE Danieli Universal Endless technology. The first plant of this type started up in August 2019 in China, just before the outbreak of the COVID pandemic. This plant is now recognized as a perfect solution to produce a wide range of thicknesses, from 1mm or less to 5mm, and we have projects for new plants going online in different areas of the world, in production within one to two years.

We are confident that this technology is now recognized as a very good way to produce thin hot strip in an eco-friendly way, maybe in the thickness range 1.5 mm and even thinner.

Why don't we see so much endless rolling in European mills?

Rolando Paolone. Good question! In my opinion, endless rolling is practically the only way to be competitive in producing rebar, and in the United States they understood this very well. Every three to four months, we are selling such a plant there, because they want to be competitive, and CO_2 also is an issue. With this solution there are 20-30 USD per tonne of savings, and with the increased cost of the gas today surely a lot more.

One of the reasons is the endless rolling mill solution gives stability and the opportunity to produce close to the minimum bar weight approved by the standards, which means less liquid steel for the same number of bars, practically lowering production cost because of continuously producing the same product. Then, you're able to keep the tolerances very, very close to the minimum. Close tolerances are always appreciated, so you can sell the required number of bars that are "lighter bars". That saves money.

What are the recent advantages in continuous casting?

Rolando Paolone. Earlier we spoke about endless rolling. At the end, the trick (if I can use this word) for the success, is the casting technology itself.

The traditional casting line speed is in the range of 3-6 meters per minute, where 5 was already fast.

With a single line operating in endless mode, given a billet dimension, the production of the entire line depends mainly on the casting speed. So, if you can increase the casting speed you increase the plant production, and the higher the plant production the lower will be the amount of fixed costs per ton of steel produced.

Consequently, our first step was to design the MIDA QLP endless casting technology with casting running at 6 metres per minute; that was already a good step forward. Since then, we kept increasing. To be honest, the rolling mill has been designed for higher productivity. Up to now, we normally run up 8.5-9 metres per minute. So, it is 50 to 60 per cent more than in the past. We are looking forward to reach 10 metres per minute.

So, with an increased billet size we are able to achieve a production of 1 million tonnes per year with a single strand. One of our Chinese customers operates an endless mill producing big billets that is going to produce slightly less: 850,000 tonnes per year. In another project in Asia, we are supplying a 1-strand-continuos casting line for a production of 1 million tons per year.

What are the secrets to reach such high productivity?

Rolando Paolone. Well, one technical detail is using a submerged entry nozzle. We do not have open flow of liquid steel into the mould. To cover the surface of the bath we use casting powder instead of oil as is normal in open stream casting. In this way, we can increase the casting speed for high quality material without problems and avoiding break out, and so on.

Also, we have developed solutions to be able to run 23.5 hours without changing anything at the caster. So, it means that in the rolling mill that is operating in endless mode we are practically running for 24 hours a day, with just half an hour that is used to change the consumables that eventually need to be changed after 23.5 hours of rolling – for example the blades of the shear, or some of the rolling rings, maybe. At the caster the entry nozzle shall be changed after 23.5 hours of operation.

Similar applications have also been developed for the flat products technology. Here, the casting speed is not 10 metres per minute, but is six metres per minute nowadays. The nozzle has been designed and tested in our R&D facility, with so many different solutions to be able to produce the slab in high quality and without risk of breakout times – all thanks to the special shape of this nozzle.

MIDA QLP endless casting technology was developed to run 23.5 hours without changes at the caster (Picture: Danieli)

At our headquarters in Buttrio, Italy, we have our Research Centre with more than 100 people working there just to develop solutions for the day after tomorrow. Today's solutions are applied by the colleagues in the product divisions. They also will handle the solutions for tomorrow. But for the day after tomorrow, we have these 100 people always thinking, studying and investing and spending money – some say: a lot of money – but if we will stop investing we won't get the future solutions.

As an example, we have an application, a machine where we can test various types of entry nozzles for casting processes, with different shapes. As we know there are two issues to be addressed when feeding so much liquid steel into the mould: mould level stability and low turbulences in the steel bath, to avoid even bubbling that will create inclusions – internal defects in the billet or slab. And the second point is an unwanted or wrong flow of liquid steel flow in the mould – a wrong flow path means a high risk for a breakout. We'll come back to this topic later.

All these solutions are going to increase the speed and especially the reliability of the casting process. The latter is fundamental in endless casting because if you lose the stream, casting will stop, and all the benefits of endless casting will fade. But we see that this does not happen.

We know the reliability of these systems is very good and proven by the US market where the endless casting and rolling is generally accepted as the "state-of-the-art" rebar technology.

In Europe we have at least four good possibilities to introduce the MIDA QLP endless casting technology concept. I think if we help the market to actually understand the advantages of the MIDA QLP technology, we will probably move forward very, very fast.

The challenge here is that it is really incredible. I remember the first time I saw a MIDA. You see this mill running smoothly, no people around. Because they don't need to do anything, while in a conventional mill there is a cut and somebody going there to pick up the samples.

Being between round and square shape, the Octagon mould combines the advantages of both (Picture: Danieli)

Have you achieved progress in the field of electromagnetic stirring?

Absolutely! Initially, the electromagnetic stirring solution was working like a mixer and thus helped to avoid metallurgical problems like segregations, etc. We have further developed this technology into a magnetic braker. This system brakes the speed of the flow of the liquid in specific areas where you don't want a "washing" at the shell, or bubbling. It will be installed soon in a thin-slab casting

Do you see a potential market for this technology in other parts of the world?

Rolando Paolone. There are so many compelling advantages of the endless operation – in terms of productivity, yield, profitability, etc. – resulting in about 20 to 30 Euro per tonne savings of transformation costs. However, steel-sector people are conservative, they are concerned about changing the technology and need to be sure their investment will be successful before moving ahead.

And then from billet to billet, they say "No, no! Wait a minute, we'll check a guide."

At the MIDA QLP, you don't check any guide because you don't need to feed one. You feed one per day! Then you can proceed, and the mill is running smoothly. So, the operator is sitting in the control room, looking at the different information from

In terms of quality wire rod – QWR, Danieli has developed a rolling mill that is fully electric, fully automatic and fully digital (Picture: Danieli)

the computers. But that's it. While, in a conventional plant, there a lot of people running around touching things, considering this and that. In a normal mill, there are normally five seconds from billet to billet. But there are delays for different reasons, frequently, and every stoppage means loss. In contrast, in the endless operation you don't stop because you go straight with the initial billet to the very end. Clearly this requires – I actually request – a change of mindset.

MIDA QLP – the endless casting and rolling process – is for the production of rebar only?

Rolando Paolone. Currently, we have the MIDA QLP minimills producing rebar, but looking forward there will also be MIDA QLP plants producing sections. It's not an easy task, I'm sure, but we are already proceeding in this direction.

Are there any other achievements in terms of long products technology?

Rolando Paolone. Besides the issues we discussed before – increase in casting speed, and so on – we also introduced another fantastic solution, which is the Octagon mould, an alternative to both the square and the round section. The square section releases heat to the mould thanks to the side that is bulging and coming in contact with the cooled mould wall. The round has no corners that can result in defects during rolling. Whereas the square section has advantages in terms of casting, the rounds are more near-net-shape with advantages for rolling. Being in between round and square, the octagonal shape combines the advantages of both.

As for the square, the Octagon strand has flat sides that are immediately coming into contact with the mould wall. It's getting "caught" or supported by the mould itself. But it also has a section that has the stability of the round, and this results in limited need for containing sectors after the mould.

The second point is that when the Octagon strand exits the mould its shape is stronger, more rigid, more self-sustainable, similar to the rounds. So, you don't need to have containing on the roller table below the mould. Also, speed can be increased during transfer to the rolling mill. The faster the transfer, the more energy is saved. Therefore, the process requires less energy at the induction heater before the first rolling stand. The octagonal mould was developed by our research centre some years ago. We tested it in some of our plants without making too much noise, but now it is an upgrade we are proposing to the customers.

By the way: from the Octagon mould we are expecting benefits also for the production of sections. But that's a topic we'll discuss during a future interview.

Danieli offers casters to produce really big rounds that can substitute for ingots. What is the benchmark here today?

Rolando Paolone. There are two different methods and products as an alternative to ingots.

First there are big sized rounds produced at a continuous caster. At ABS, they produce continuous cast rounds with maximum 850 millimetres diameter. These rounds are the ideal feedstock for the Rotoforge process introduced ten years ago. The Rotoforge machine – actually an oversize rolling mill with maximum rolling force – is able to produce bars with a quality that is similar to the open-die forging process in terms of internal quality, combined with a better exterior quality – and what is more, the productivity is five times higher than forging.

And now, we have developed another solution for giant rounds that is, however, not really casting in a continuous mode. We cast rounds with up 1.3 metres diameter, 12 to 15 metres long. These are produced on two casting lines, subsequently. You need to know that when producing ingots, you need to remove head and tail to avoid defects on the final product. It is the same for these long rounds but being (for example) three times longer than a typical ingot, the effect of head and tail is just one third as much.

These big castings have the advantage that, as in ingots, the usual impurities are at the bottom and at the top and can be removed.

So, the giant round is trimmed to the desired length. With that in mind, such rounds can be produced with a high yield and competitive costs on this casting machine.

The first implementation of this technology will again be in China for cast rounds with diameter 1.2 metres and a length of 18 metres.

Is there any other news about your long products segment?

Rolando Paolone. May I add some facts about quality wirerod - QWR. Here we have developed another advanced technology. We now implement a new type of wirerod mill. This mill has a lot of features, which are unique in the world.

First of all, it's a fully electric mill. In fact, every drive of this mill is electric – no oil, no hydraulics, etc. Normally, changing of stands and movement of some other equipment is done by hydraulics because that used to be easier, or for example cheaper. But if there is oil, there is also a hydraulic unit, where electricity is converted to hydraulic power, consequently with some loss of energy for the transformation.

In this new type of mill, we don't have hydraulic units at all. We use electrical energy to power all drives.

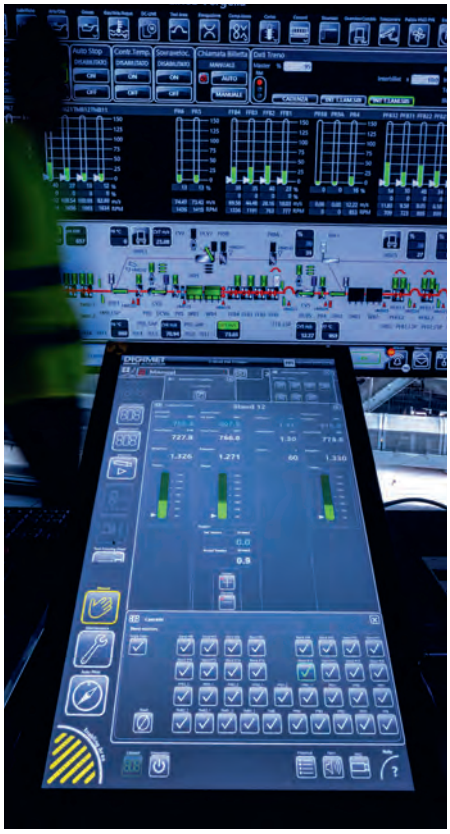
Second point: it is fully automatic. All the subsequent processes to change the wire dimensions are executed by the automation system. The operators on the pulpit push a button and the stands are changed automatically. For a mill with a broad variety of products and the need for many changes every day, it's clear that this is a big step forward.

The fully automatic rolling mill is part of our "Ready to Roll" philosophy that we are pushing, because any rolling mill can only be efficient and productive when it is running most of the time. Since every stop means a loss, stoppages shall be minimized. Every change shall be prepared outside the mill while it is running. And this is possible, but it's not easy. It's not automatic per se.

Another point is that this plant is able to do different heat treatments along the mill, what actually is a thermo-mechanical process. There is a broad range of processes available for different steel grades, beginning with low-temperature rolling, slow cooling or fast cooling. One special feature is the water segment of the conveyor that uses pouring water for fast-controlled cooling of the wirerod. It is a special treatment for some kinds of high-carbon steel, for example.

Next point is on the automation. This fully automatic rolling mill is equipped with special applications to supervise the process. If there are specific incidents or events during operation the app can log a POI – point of interest. If the operator wants to know what has happened exactly at a certain time he can push a button, and the system records all the information before and after that point. This enables the operator to analyse offline everything that happened.

There are all types of information available, like torques, speed, temperatures, and so on – even from digital cameras. The solution of the "point of interest" is fantastic, because if something strange happens during rolling, nobody is able to recognize every detail of the huge plant. Our automation system now has the option to do a post-process analysis. This analysis can be done in another room close by the pulpit, where the people can go and analyse the data and understand the problem or incident.



The fully automatic rolling mill is equipped with special applications to supervise the process (Picture: Danieli)

To summarize: we have developed a wirerod mill that is fully electric, fully automatic and fully digital. This technology has been in operation at ABS since November last year. While at ABS the solution is unique so far, we are convinced that wirerod companies will be interested to implement at least some parts of this comprehensive technical solution in their plants.

Can you give an example, please?

Rolando Paolone. An example is the reheating furnace with the possibility to reduce by half the scale formation. Recently this has been sold to a customer in the United States, who has ordered equipment for their rolling mill. During the conversa-

DSD – the Drawer has been recognized as a breakthrough 4-roll technology in the field of bar sizing mills (Picture: Danieli)

tion they wanted to know more about our furnace technology. In the end, they bought it just for this reason, reduction of scale.

But we have more such compelling solutions on offer, for instance our sixth-generation billet welder and the famous spooler technology. We introduced the Danieli spooler for 5-ton coils a decade ago. Now the spooler is able to handle 8-ton coils. The pros are still the same: it mainly increases the yield because the remaining part of the coil will be shorter.

Next, for billet welding we have developed a totally new generation. The traditional billet welder works well to the advantage of our customers. However, it requires the usual maintenance to keep it clean. We identified that as a drawback during a meeting with a customer and immediately started a cooperation to develop a new billet welder together. After a fantastic team effort, we found the perfect solution, which was evaluated by the user.

We have developed this machine, which is completely different from all other billet welding machines that exist. It has the same good efficiency and reliability, but on top of that it is very easy to clean – and the advantage is higher yield and less maintenance.

Next, you have a new development in the field of bar sizing mills. Would you please explain that?

Rolando Paolone. We have developed a breakthrough technology for the sizing mill named DSD, the Drawer.

The traditional solution for this task was a 2-roll stand in horizonal and vertical design. Then, someone else invented a 3-roll reducing and sizing mill, which was a great improvement.

However, we introduced 4-roll technology. The big advantage of the 4-roll solution is that there is very little spread, i.e., the material is formed forward and does not spread outwards. With four rolls 95 or even 100% of the material is formed towards the front of the bar and a perfect cross-section can be achieved. In addition, the machine can change from format to format very quickly. In demanding SBQ production with several batches, the rolling mill therefore does not have to be stopped, as it can be switched immediately to the next size between bars. Two feeds can therefore be used in the mill as this sizing mill is able to reduce from the same feed and produce a wide range of bar sizes without changing the mill by simply closing the rolls.

When the roll stand is set to a nominal dimension of 25 mm, the roll stand can be changed down to 23.5 mm and also up to 27 mm – simply by opening and closing the rolls, without having to change or adjust the roll stands. This is the great advantage of this 4-roll technology – the Danieli design that no one else offers.

For all these innovations Danieli must be an employer of masterminds and creative geniuses, with a lot of patents, right?

Rolando Paolone. That is also interesting. For us, in a way, the number of patents we achieve is a KPI, but it's not an end in itself. Sometimes we don't apply for the patent to avoid sharing too much info with the competitors, so because we think it's bet-

ter to get from design to production as quickly as possible. We apply for the patent when the protection obtained is stronger than the risk from sharing information and we really want to protect the solution.

Danieli entered the field of seamless tube plants some years ago. What have you achieved so far?

Rolando Paolone. For us this segment is a niche compared with rolling mills for rebar or sections, where we deliver more plants per year but we have introduced new solutions and developments with different advantages.

For the seamless tubes we have developed different plant layouts that are more competitive, more flexible and have a shorter length of the mill than a traditional plant. A more compact plant also means that it is easier to finish or manage the plant, because if the workers don't have to run back and forth to follow the mill, they can work better.

This is for seamless, but we also are investing in the welded pipes process (ERW mainly).

We are studying revolutionary, high-speed lines, 1.000 FPM, able to safely increase the productivity and increase our customers' competitiveness in the segment of light, smaller pipes.

What is your contribution to the decarbonisation of steel production?

Rolando Paolone. Hydrogen and biomass are related to the possibilities for future fossil-free fuels that will come sooner or later. We already have the possibility to use fuels like hydrogen in our reheating furnaces. Hydrogen as a substitute for natural gas is already ready for use.

We are now in the process of developing solutions to avoid fossil fuels, especially natural gas, in heating ladles, tundishes and other equipment in the steel plant. So, we are ready to sell solutions with burners that can use a mixed gas that ranges from zero natural gas to 100% natural gas and every ratio in between.

What is Danieli doing in the area of digitalisation?

Rolando Paolone. Well, digitalisation is included in practically all our projects. For example, I already mentioned Danieli Automation when I talked about the Point of Interest application. We also have the possibility to use artificial intelligence. For the electric arc furnace, we have the "MeltModel", which is an application using neural networks. This is a fantastic tool, because if someone builds a new plant and starts a new meltshop for the first time, there are hardly enough skilled people available. So, we offer this application called "MeltModel". The result is a very fast learning curve, which means that the return on investment is very quick. As you can imagine, Big Data analytics is the new path we have taken. So, the I4.0 technology is there and we already are thinking about I5.0 or so.

Thank you very much for the interview.

The remote interview via the internet was conducted by Arnt Hannewald, editor-in-chief of STEEL + TECHNOLOGY magazine

"Competitive OpEx today means Green Metal technologies," says Rolando Paolone, Danieli Group CEO and CTO (Picture: Danieli)

The CO_2-free production of liquid steel in hydrogen plasma is being researched in the pilot facility (Picture: voestalpine)

Showcase project for the green steel of the future

voestalpine researching into hydrogen plasma for steel production

As part of the "sustainable steelmaking" (SuSteel) research project, the Austrian company will investigate the use of hydrogen plasma in a carbon neutral steel production process

Austrian steel company voestalpine is striving to produce carbon neutral steel by 2050, in accordance with the European climate goals. The global Group is already working hard to develop highly innovative technologies and production processes with "greentec steel", its ambitious phased plan. In a new pilot facility in Donawitz (Austria). voestalpine is currently the world's only steel manufacturer conducting research into the use of hydrogen plasma in steelmaking.

At the new pilot facility, which commenced operation in Donawitz in 2021, research is being conducted into the use of hydrogen plasma for the carbon-free manufacture of crude steel in a single process step. Conventional steel production uses coke, coal, or natural gas as a reducing agent for ores. The SuSteel project replaces these with hydrogen. Hydrogen plasma is used to simultaneously reduce iron ore and smelt it into crude steel in a special direct current electric arc furnace. The advantage of using green electricity and hydrogen as the reducing agent is that water vapor is the only end product, completely avoiding carbon dioxide emissions.

"We are working at full speed on novel processes which will allow us to achieve

> "Our two flagship projects, H2FUTURE and SuSteel, make us global pioneers in the industry when it comes to researching the use of green hydrogen to apply new technologies in steel production."
>
> *Herbert Eibensteiner, CEO of voestalpine AG*

the breakthrough of decarbonizing steel production at the sites in Linz and Donawitz," says Herbert Eibensteiner, CEO of voestalpine AG. "Our two flagship projects, H2FUTURE and SuSteel, make us global pioneers in the industry when it comes to researching the use of green hydrogen to apply new technologies in steel production," explains Eibensteiner. Project partners joining voestalpine in this basic research project include the K1-MET competence center for metallurgy, and the Montanuniversität Leoben. SuSteel is a COMET project, initially funded by K1-MET via the Austrian Research Promotion Agency (FFG) until 2023.

voestalpine is consistently following its plan to achieve climate-neutral steel production. The aim is to partially replace the existing blast furnace route with hybrid steel production using electricity as of 2027, and to successively increase the share of green hydrogen used in the steel production process to 2050. "The requirements for realizing this revolutionary vision are clear: green electricity and hydrogen must be available in sufficient quantities and at prices which reflect market conditions," Eibensteiner adds.

Donawitz as an innovation hotspot

The voestalpine works premises in Donawitz were deliberately chosen as the site for the new pilot facility. Here at the Group's site in Styria, the voestalpine Metal Engineering Division will produce high-grade steels for processing into special rails for railway infrastructure, premium wires for the automotive industry, and high-quality seamless tubes for oil & gas exploration. "We are continually investing in research and development, as well as pioneering production facilities, which explains our longstanding reputation as a driver of innovation and excellent research hub. Consequently, the new testing facility is embedded in an ideal testing environment," says Franz Kainersdorfer, Member of the Management Board of voestalpine AG and Head of the Metal Engineering Division. Recent investments at the Donawitz site include the TechMet, a metallurgy technical research center for the production of high-performance steels, as well as the world's most advanced and fully digital continuous casting line. The site also benefits from its proximity to the Montanuniversität Leoben; as part of the SuSteel project, this was the site of a first laboratory used to make steel by smelting around 100 grams of iron ore. The findings have now been used in the voestalpine pilot facility which can smelt around 90 kilos of ore.

voestalpine

Herbert Eibensteiner (left) and Franz Kainersdorfer want to position the Donawitz site as an innovation hotspot for the voestalpine Group (Picture: voestalpine)

Fossil-free ressources

Renewable biocarbon materials displace fossil fuel-based inputs in steel production

Cleantech innovator Aymium completes strategic financing backed by global leaders in steel and metals production. Investors include Nippon Steel Trading, Steel Dynamics, and Rio Tinto

Aymium, one of the leading producers of renewable biocarbon products, announced that it has secured Series B funding to support capacity expansion and increased deployment of its environmental technologies bringing total investment in the company to over $200 million.

Aymium's products, including biocarbon and biohydrogen are engineered to immediately displace fossil fuel-based inputs – such as coal or coke in steel and metals production – without the need for any type of plant modifications. "Our mission is to accelerate the transition away from fossil fuels and reduce the impact on the environment," said Aymium CEO James Mennell. "Aymium's products allow immediate replacement of fossil fuels with renewable, carbon negative inputs without any changes to existing manufacturing processes or equipment. This investment and partnership will further advance our mission of improving the environment with our new partners on a global scale."

Biocarbon is engineered to immediately displace fossil fuel-based inputs – such as coal or coke in steel and metals production – without the need for any plant modification
(Picture: Amyium)

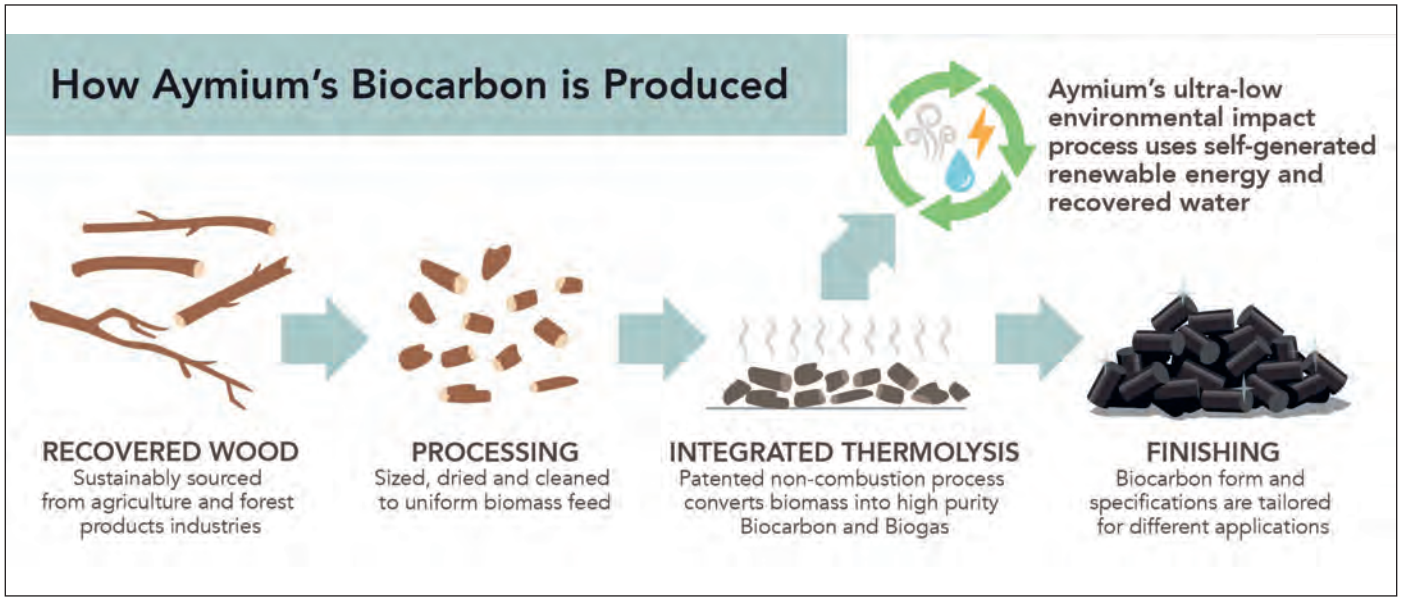
Every ton of Aymium's product used in place of coal results in a net reduction of over five tons of CO_2. Strategic investors are interested in displacing fossil fuel inputs in their facilities for metals production and use of Aymium's products to accelerate their decarbonization initiatives.

Aymium operates the largest advanced biocarbon production facility in North America located near Marquette, Michigan (USA). Aymium's patented process converts certified sustainably sourced biomass into biocarbon using integrated thermolysis. The non-combustion process converts biomass to high purity biocarbon and biogas, recovers and recycles water from the biomass, and is powered by self-generated renewable energy. Aymium's process produces the only commercially demonstrated carbon-negative input for global steel production.

"With this capital raise, Aymium has brought in a collection of strong global partners who are both leaders in their respective fields as well as leaders in the transition away from fossil fuels," said Tom Wood, co-CIO of Sandton Capital, Aymium's lead investor. "Sandton made its original investment based on Aymium's proven operating history and the clear opportunity for its patented, renewable replacement for coal-based products. This investment represents an important next step in the growth of Aymium as well as a clear validation of its products, technologies and management team."

"We are incredibly excited to make this important investment to support Aymium's mission to advance renewable biocarbon production," said Theresa E. Wagler, executive vice president and CFO of Steel Dynamics, Inc. "Our commitment to all aspects of sustainability is embedded in our founding principles – valuing our teams, our partners, our communities, and our environment. This investment and our

> "Our mission is to accelerate the transition away from fossil fuels and reduce the impact on the environment."
>
> *James Mennell, Aymium CEO*



The patented process converts certified sustainably sourced biomass into biocarbon using integrated thermolysis (Picture: Amyium)

Aymium operates the largest advanced biocarbon production facility in North America located near Marquette, Michigan/USA (Picture: Amyium)

"We are delighted to become an equity partner in Aymium," said Sinead Kaufman, chief executive of Rio Tinto Minerals. "This investment is aligned with our strategy of partnering in the development of leading-edge technologies with the potential to help deliver lower carbon footprints and environmentally sensitive solutions when producing essential minerals and metals."

Credit Suisse Securities (USA) LLC acted as exclusive placement agent in connection with Aymium's Series B financing. Latham & Watkins, LLP acted as legal counsel to Aymium.

Aymium

planned strategic relationship with Aymium represent a significant step on our path to carbon neutrality, and our continued commitment to reduce our environmental footprint."

Proceeds from the financing will be used to advance construction of Aymium's newest production facility in Williams, California and another in the Pacific Northwest. The new facilities will employ over 125 people combined and will be operational in 2023. Production from both plants is contracted through 2037 and is projected to reduce over 1.4 million tons per year of CO_2-equivalent to removing over 300,000 cars per year from the road.

A potential regional champion is emerging

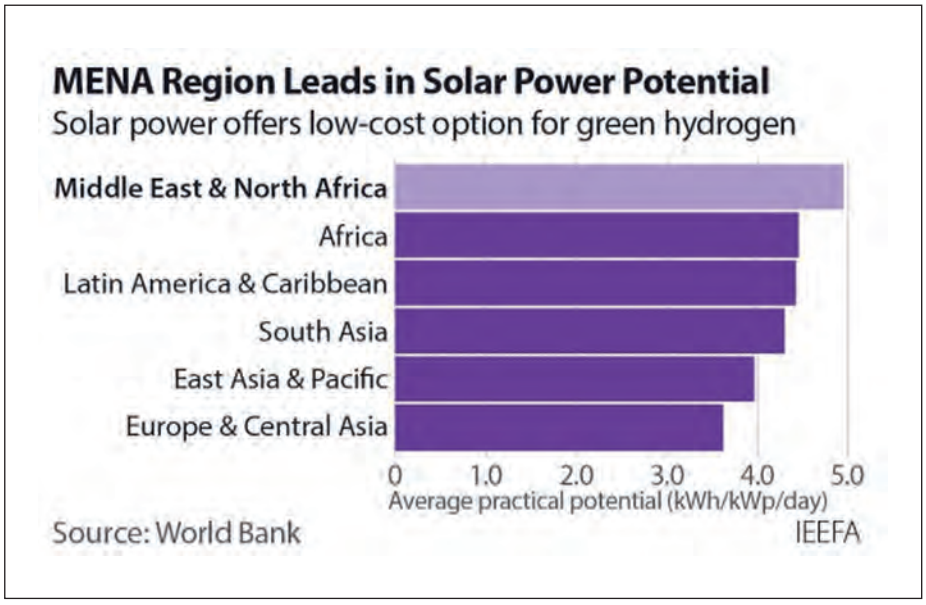
MENA region can lead global steel decarbonisation with investment in green hydrogen and renewable energy

Egypt, Saudi Arabia and the Emirates are MENA's pioneers in shifting towards renewables and green hydrogen with steel companies typically already using DRI-EAF technology

As the global steel industry eyes switching to direct reduced iron (DRI) production and using green hydrogen to reduce emissions, the Middle East and North Africa (MENA) region is in a prime position to start producing carbon-neutral or green steel, finds a new report from the Institute for Energy Economics and Financial Analysis [1]. "The MENA region can lead the world if it shifts promptly to renewables and applies green hydrogen in its steel sector," says author of the report Soroush Basirat.

Fortuitously, the region's sector is dominated by direct reduced iron-electric arc furnace (DRI-EAF) technology, which releases lower emissions than the increasingly obsolete coal-fuelled blast furnace and basic oxygen furnace (BF-BOF) process used in 71% of global crude steel production in 2021. Basirat says the DRI-EAF process, which uses syngas made from natural gas or gasified coal and also electricity, could be zero emissions if green hydrogen (produced using renewable energy-powered electrolysis) and electric arc furnaces powered by renewable energy were used. According to his analysis, MENA has an established supply of DR-grade iron ore and its iron ore pelletising plants are among the world's largest. In 2021, MENA produced just 3% of global crude steel but accounted for nearly 46% of the world's DRI production.

"MENA's knowledge of this specific steel technology is an invaluable asset. This production knowledge, abetted by further work on iron ore beneficiation, pelletising and DR plants, is among the most important steel decarbonisation pillars, and will greatly assist MENA's transition," Soroush Basirat says. "Compared to other regions, MENA's existing DRI-EAF capacity means no extra investment is needed for replacing the base technology. All new investment could be focused on expanding production of green hydrogen among other renewables." If it acts fast, MENA has the potential to lead the world in green steel production



The report notes new renewable capacities will change the power mix in the MENA region (Picture: IEEFA)

The International Energy Agency (IEA) in its Net Zero Emissions scenario models the global share of hydrogen-based (H_2) DRI-EAF production reaching 29% of primary steelmaking by 2050. BloombergNEF estimates that 56% (840 million tonnes) of primary steel production will come from H_2DRI-EAF by 2050 in a net zero emissions scenario. Soroush Basirat notes MENA has excellent solar resources to aid production of green hydrogen from renewable electricity. "A switch from gas-fuelled DRI to green hydrogen could commence ahead of other regions, given MENA's in situ capacity of DRI-EAF," he says. "Initially, it would be possible to replace 30% of gas with hydrogen in the incumbent fleet of DR plants without any major equipment modifications. The region could then move towards 100% green hydrogen to produce carbon-free steel."

"A switch from gas-fuelled DRI to green hydrogen could commence ahead of other regions, given MENA's in situ capacity of DRI-EAF."

Soroush Basirat, Energy Finance Analyst, IEEFA

The World Bank found MENA has the highest photovoltaic power potential capacity globally and could theoretically

produce more than 5.8 kilowatt hours (kWh) per square metre daily. It is predicted that 83 gigawatts (GW) of wind and 334GW of solar power will be added by 2050, increasing the share of wind and solar from 1% and 2% respectively to 9% and 24%.

"Having access to such high solar energy resources allows for production of green hydrogen at a competitive price," says Basirat. "With MENA's available capacity, producing green hydrogen below $1/kg is achievable by 2050."

Demand for green steel is rising globally, led by European car manufacturers

"With the European Union soon establishing a Carbon Border Adjustment Mechanism, MENA steel exports would have an advantage if they were zero carbon," says Basirat. "MENA's producers are ahead in terms of their market positioning and will remain so if they accelerate the transition to carbon-free steel using the green hydrogen DRI-EAF route. Providing green electricity, a big challenge for steel producers in some parts of the world, is not a barrier in MENA."

Egypt, Saudi Arabia and UAE are MENA's pioneers in shifting towards renewables and green hydrogen. Fortescue's recently announced green hydrogen facility, with an ambitious capacity of 9.2GW, could be one of the largest plants of its kind. Saudi Arabia's investment to produce green hydrogen from the Mohammed bin Rashid Al Maktoum Solar Park and the joint investment of Emirates Steel and TAQA are among the tens of green project announcements in the MENA region.

"With ample renewable energy potential, the region could become a leader in hard-to-abate and carbon intensive industries, specifically steel," Basirat concludes.

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends, and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy.

[1] Soroush Basirat. Green Steel Opportunity in the Middle East and North Africa. Institute for Energy Economics and Financial Analysis (IEEFA), 2022

Climate-neutral future of hot metal production

H2Stahl project to start at the ironmaking site of thyssenkrupp Steel in Germany

While the use of hydrogen in the blast furnace is to be expanded, the German steel company will build a pilot plant for hydrogen-based direct reduction of iron ore

The real-world laboratory of the energy transition that has been granted funding in the amount of 37 million euros by the Federal Ministry for Economic Affairs and Climate Action will be implemented. By launching the H2Stahl project in Duisburg, the consortium members thyssenkrupp Steel, Air Liquide Deutschland and VDEh Betriebsforschungsinstitut (BFI – the project coordinator) have now set the course for the first steps. The tasks at hand are as following:

- expansion of the use of hydrogen to the entire blast furnace 9,
- construction of a pipeline for testing the large-scale industrial use of hydrogen in steelmaking,
- construction and trial operation of a direct reduction pilot plant.

The entire cost of the project to be implemented within a five-year period amounts to a high double-digit million figure.

Large-scale use of hydrogen in the blast furnace

In November 2019, thyssenkrupp Steel was the first company globally to inject hydrogen into a running blast furnace. However, the first series of tests were executet just on one tuyere of blast furnace No. 9 in Duisburg, and the tests were completed successfully. The focus of the project was in particular to gain knowledge about the plant technology when using hydrogen.

Within the scope of the real-world laboratory H2Stahl, the use of hydrogen will now be expanded to all 28 tuyeres of the blast furnace. The objective of the research is – amongst others – investigating the influence of the industrial use of hydrogen on the metallurgical processes in the blast furnace and determining parameters for the efficient use of reducing agents. The overall aim is to establish the use of hydrogen as bridging technology for the technical CO_2 reduction in existing blast furnaces. Provided that sufficient quantities of green hydrogen are available, CO_2 emissions can be reduced by up to 20 percent on one plant. To secure the continuous hydrogen supply of the blast furnace, the project partner Air Liquide will build an about six kilometers long pipeline linking the steel plant in Duisburg with Air Liquide's production network.

Direct reduction pilot plant

As part of the H2Stahl project, a direct reduction pilot plant will also be built in order to prepare the technology changeover from the conventional blast furnace route to the hydrogen-based direct reduction process. The use of hydrogen-containing process gases in combination with natural gas and pure hydrogen is to be tested in the new plant to be designed, which will be operated and scientifically supervised by BFI.

Aside from the commonly used feedstock for direct reduction plants, other materials containing iron oxide, including potentially suitable waste materials, will be used. The direct reduction pilot plant will be equipped with additional measurement technology enabling scientific evaluation. The tests in the direct reduction pilot plant will be accompanied by modeling and special studies in the Technical Center of BFI.

The planned research work will focus on the investigation into the reduction processes and process parameters in order to ensure the smooth transition to the future large-scale plants. "The flexible use of hydrogenous gases as well as various feedstock containing iron oxide in a direct reduction process is quite a challenge. The scientific investigations will provide essential information on the safe and efficient operation of the processes as well as the appropriate operating parameters", says Michael Hensmann, head of resource technology feedstock department of BFI. thyssenkrupp plans to complete the first industrial direct reduction plant including melting unit by 2025.

Consistent implementation of the transformation strategy

The launch of the H2Stahl project marks the next important milestone on the way towards climate-neutral steel production. "We are now starting to prepare our plant infrastructure for the large-scale industrial use of hydrogen", explains Dr. Arnd Köfler, thyssenkrupp Steel's CTO. "With the pipeline link to the existing hydrogen infrastructure of Air Liquide, we are giving another impetus for ramping up the production of green hydrogen as quickly as possible, because there is a demand for it".

H2Stahl does not only permit to gain important information on the changeover to direct reduction: The use of hydrogen in the blast furnace permits to significantly reduce CO_2 emissions – depending on the availability of green hydrogen. "With H2Stahl we combine two phases of our climate strategy: on the one hand the industrialization of hydrogen use in existing blast furnace-based technology routes already involving significant CO_2 reductions in the production process, and on the other hand the preparation of the direct reduction process by building up the infrastructure and thoroughly preparing the technological process", adds Köfler.

thyssenkrupp Steel Europe AG

AFRICA: ALGERIA

Tosyali Algeria orders electric arc furnace

Tenova has been awarded a contract by Tosyali Algeria for the supply of a new electric arc furnace (EAF) to be installed at Tosyali's Bethioua plant.

The new furnace will be of almost identical design as the EAF supplied by Tenova to the Bethioua site in 2016. The new equipment, powered by a 240 MVA AC transformer, will process 2.5 million t/year of DRI pellets to produce hot rolled coil. Like the existing EAF, the new furnace will be equipped with an innovative charging system that allows charging and melting of more than 12 t/min of HDRI (hot-DRI).

The existing furnace has been fed with a wide range of reduced iron sources including hot briquetted iron (HBI). In addition, the composition of the DRI produced and processed at the Bethioua site is adjusted by blending in iron concentrates from different sources to achieve the most profitable balance between cost of raw materials and energy. The advanced process control system compensates for the variations in raw materials and optimizes the process to achieve optimal yield and consumption figures.

Electric arc furnace in operation (Photo: Tenova)

Tenova

AFRICA: EGYPT

Suez Steel to revamp continuous caster

Suez Steel has contracted Danieli to upgrade its No. 2 continuous caster to expand production capability and flexibility.

Once upgraded with Danieli's combicaster technology, the caster will be able to produce more than 1 million t/year of billets and rounds and a range of new sections. The caster will be equipped with submerged casting and Danieli Rotelec electro-magnetic stirrer technologies – mould and final EMS – to suppress center segregation and improve internal product quality. An existing lateral strand will be replaced with a new strand, redesigned from the mould to the discharge area, to enable the casting of jumbo dimensions. Production of the new sections is scheduled to start in the third quarter of 2023.

Danieli

THE AMERICAS: BRAZIL

ArcelorMittal acquires Companhia Siderúrgica do Pecém

ArcelorMittal has signed an agreement to acquire Companhia Siderúrgica do Pecém (CSP). The state-of-the-art steel facility in the state of Ceará in northeast Brazil was commissioned in 2016.

CSP operates a 3-million t/year blast furnace and has access via conveyors to the Port of Pecém, a large-scale deep-water port located 10 kilometers from the plant. CSP operates within Brazil's first Export Processing Zone and benefits from various tax incentives.

The state of Ceará has ambitions to develop a low-cost green hydrogen hub. The Pecém Green Hydrogen Hub, a partnership between the Pecém Complex and Linde, is a large-scale green hydrogen project at the Port of Pecém.

ArcelorMittal

THE AMERICAS: BRAZIL

Aperam to modernize Steckel mill plant

Aperam South America has contracted Danieli for revamping its Steckel mill plant in Timoteo, Minas Gerais. The target of this project is to widen the product portfolio to better meet the market demand for higher quality products.

After the upgrade, the Steckel mill plant will enable Aperam to produce electrical, carbon, 410T-grade stainless steel, as well as Inconel 625, Duplex 2101 and 2205, and 3xx- and 4xx-series stainless steel, non-grain-oriented and grain-oriented silicon steel in thicknesses down to 1.8 mm.

Danieli will focus on four areas: the roughing mill, installation of a new finishing Steckel mill, the laminar cooling system and the downcoiler area. The process control and automation system of the entire Steckel mill will be modernized, integrating both new and existing equipment. Before the main shutdown for the installation of the new mill stand, the new Level 1 and Level 2 control systems will be duly tested on site in shadow mode. The existing finishing stand will be replaced by a new one, equipped with modern automation control and advanced mill features, such as HAGC, bending, shifting and thermal-crown control. The modernization is scheduled for completion by 2023.

Aperam South America

Gerdau Araçariguama to upgrade rolling mill

The service team of Danieli do Brasil will supply and install a new surface quenching and self-tempering system for bars at Gerdau Araçariguama.

The Danieli QTB system will replace the existing bar treatment line to improve the mechanical properties of rebars produced by Gerdau Araçariguama. Bars processed with the QTB system achieve international standards (ASTM, DIN, BS, ABNT) without the need of any downstream cold-working practice. The new QTB system will include tools for quick replacement, aligning and setup of cooling elements. This will drastically reduce changing times and increase operational safety. Start-up is planned for the second half of 2022.

Danieli

Smart Steel Technologies to implement AI solution at Vallourec Soluções Tubulares

Vallourec Soluções Tubulares do Brasil S.A. has chosen Smart Steel Technologies to implement an AI-based temperature control solution.

Seamless steel pipe producer Vallourec Soluções Tubulares do Brasil is going to implement "SST Temperature AI" at its Jeceaba production site. The SST solution will provide precise temperature control from the electric arc furnace via the ladle furnace and vacuum degasser to the continuous caster. It will be integrated live into the production process. This will enable Vallourec to minimize temperature buffers and optimize production temperatures. Through increased process stability, Vallourec will save energy costs, CO_2 emissions and improve product quality. Installation of "SST Temperature AI" will take just a few months, followed by a three-month test and optimization phase.

Vallourec Soluções Tubulares do Brasil

THE AMERICAS: MEXICO

Steel Dynamics acquires Roca Acero

Roca Acero S.A. de C.V., a ferrous and nonferrous scrap metals recycling business, has been sold to Steel Dynamics, Inc.

This transaction will enable Steel Dynamics to further solidify its Southwest U.S. and Mexico growth strategy, which includes strengthening the company's raw material procurement strategy in the region and providing an even more meaningful competitive advantage to its U.S. electric-arc-furnace steel operations.

Roca is headquartered in Monterrey, Mexico, with primary operations comprising four scrap processing facilities, strategically positioned near high-volume industrial scrap sources located throughout Central and Northern Mexico. These combined facilities currently ship approximately 575,000 t of scrap annually and have an estimated annual processing capability of approximately 850,000 t.

Steel Dynamics

THE AMERICAS: USA

CMC Steel implements new digital power feeder for ladle furnace

CMC Steel has replaced the existing ladle-furnace transformer at its Arizona No. 1 minimill with a Danieli Q-One digital power feeder.

The new system allows the furnace to operate at variable frequencies. In tests, the ladle furnace at CMC Steel Arizona has been operated down to 20 Hz instead of the nominal 60 Hz.

CMC Steel Arizona is a Danieli QLP MIDA endless casting-rolling minimill with a design capacity of 350,000 t/year of quality rebar in bundles and spools supplied in 2009.

Danieli

Fives launches new low-NOx burner solution

Fives has formally released its newest, patented, low-NO_x burner solution, North American EcoFornax™ SLEx, for process heating and oxidation applications.

The new product incorporates innovative air/fuel mixing technology, engineered to deliver a stable, compact, medium velocity flame with low-NO_x emissions. The single air and gas connections are designed to make burner installation and tuning easy. The EcoFornax™ SLEx has been implemented and proven in industry applications such as regenerative thermal oxidizers, air heaters, process heaters, direct fired rotaries and aluminium homogenizers. The burners can operate across a wide ratio range from 20% excess fuel to 90% excess air. Its versatility and compatibility with hard refractory or fiber wall lined furnaces make the EcoFornaxTM SLEx a simple and sustainable solution for process heating systems.

Fives

THE AMERICAS: USA

Nucor to build new rebar micro mill in North Carolina

Nucor Corporation will build a new rebar micro mill in Lexington, North Carolina. This will be Nucor's third rebar micro mill, joining existing Nucor mills in Missouri and Florida.

"We are very excited to grow our steel business here in our home state of North Carolina. The corridor between Washington, D.C., and Atlanta is one of the fastest-growing regions in our nation, and new federal spending for infrastructure will further increase demand for rebar in the region," said Leon Topalian, President & Chief Executive Officer of Nucor. Nucor Steel Lexington will produce steel with nearly 100% recycled content.

Nucor

Nucor to add melt shop at its Arizona bar mill

Nucor Corporation is adding a new melt shop with a capacity to produce 600,000 t/year of steel at its bar mill in Kingman, Arizona. In September 2021, Nucor announced its intention to build a new melt shop. Nucor Steel Kingman was chosen as the ideal location for this project because it is a rolling mill that converts steel billets into coiled wire rod and rebar but lacks a melt shop. Construction of the melt shop is expected to take two years pending permit and regulatory approvals.

Nucor

Optimus Steel modernizes rolling mill

Optimus Steel has selected Danieli technology for a comprehensive revamp of the rolling facilities at its Orange County, Texas, minimill.

The project covers different technology areas and is being carried out in several steps. The first modernization step has already been implemented. Two new high-speed shears for automatic bar cropping have been installed between the wirerod finishing blocks and the new Danieli oil-film bearing laying heads. A new, Sund Birsta, coil finishing end completes the wirerod mill modernization.

The installation of a new,140-t/h high-speed bar-finishing line is in progress and will be completed by 2023. Optimus Steel has also approved the investment in a new re-heating furnace and a new twin rolling mill. The new, 140-t/h Danieli Centro Combustion walking-beam furnace will feed two independent rolling lines. The new mill will operate with cantilever-roll stands. To be installed at the entry side of the two new rolling lines, an energy-efficient Q-Heat induction heater will improve material quality by controlling scale formation. Upgrading the existing water-treatment plant serving the minimill and the supply of a new one to guarantee even higher environmental standards is also part of the contracted package. The overall modernization project is expected to be completed by 2024.

Danieli

ASIA: CHINA

Baosteel selects DRI technology for new 1 million t/year project

Construction site for new DRI project (Photo: Danieli)

Zhanjiang Iron & Steel has ordered Energiron® ZR DRI technology, developed by Tenova and Danieli, for its new direct reduction plant to be installed in the Zhanjiang Economic and Technological Zone in the province of Guangdong.

Featuring Energiron® ZR – Zero Reformer technology, the new plant will produce 1 million t/year of quality DRI by using natural gas, coke-oven gas or up to 100% hydrogen. The DRI produced by Baosteel

ASIA: CHINA

Zhanjiang will satisfy the need of virgin DRI of the group. The plant is scheduled to be commissioned by 2024. Energiron® DRI plants can capture the CO_2 generated by the reduction process. They are hydrogen-ready by design and can start using hydrogen as reduction gas without equipment modifications.

Tenova, Danieli

Fujian Sangang Minguang issues FAC for mill modernization

The commissioned reducing & sizing block for bar-in-coil and straight bar production (Photo: Kocks)

Fujian Sangang Minguang (Sanming) issued the final acceptance certificate for the new Kocks 3-roll reducing & sizing block installed in Sanming's SBQ mill.

As part of a modernization of its SBQ mill, Kocks supplied an RSB® 370++/4 in 5.0 design. Arranged as a finishing unit after a 21-stands H/V rolling mill, it produces bar-in-coil in diameters ranging from 16 to 48 mm and straight bars in diameters ranging from 20 to 90 mm in an 800,000 t/year mill. The FAC for the Kocks block was placed just four weeks after rolling the first bar.

In addition to the equipment supplied by Kocks, the modernization project included new H/V stands, shears, a new bar-in-coil line with finishing facilities and the upgrade of the inspection line.

Kocks

ASIA: CHINA

Baowu orders cold rolling mills for electric steel

Baowu has entrusted Fives with the design and supply of two reversible cold rolling mills with automatic roll change for the production of electric steel. The mills will be installed at the Baoshan and Wuhan sites respectively.

Fives will supply two DMS 20Hi EcoMill for grain-oriented (GO) with high permeability and non-grain oriented (NGO) electric steel. The mill for the Baoshan site will have a split housing, the one for Wuhan will be a monobloc mill. The split-housing mill allows for a larger gap between the upper and lower work rolls during maintenance and changeover, while the monobloc mill provides better mechanical stability and dimensional properties.

The project also includes a fully automatic roll change system, RollBot™, that performs fast, precise and safe roll change with no manual intervention, ensuring optimal safety and product quality.

Fives

ASIA: INDIA

ArcelorMittal Nippon Steel India to build new coupled pickling line and tandem cold mill

Shaking hands during the contract signing ceremony (Photo: Primetals Technologies)

ArcelorMittal Nippon Steel India (AM/NS India) has ordered a coupled pickling line and tandem cold mill from Primetals Technologies for its site in Hazira, Gujarat.

Primetals Technologies is responsible for engineering, supply of main and auxiliary equipment, and electronics and automation, and will be supervising the construction and commissioning processes. The existing hot-strip mill will supply hot-rolled coil to the new PLTCM line. After pickling, the coil will either be processed as hot-rolled pickled and oiled steel or sent to the tandem cold mill for cold rolling. The tandem cold mill will be designed as a 6-high universal crown control mill for producing steel grades ranging in width from 900 to 1,890 mm.

AM/NS India's new pickling line will feature Primetals Technologies iBox technology, consisting of an energy-efficient pickling tank. Made of polypropylene, a superior material in heat retention, the iBox improves pickling capacity without the need for continuous recirculation of acid by running pumps as is commonly required in conventional jet pickling tanks to circulate the acid solution. Primetals Technologies will also supply the complete electrical and automation system including power supply, AC main and auxiliary drives, basic and process automation, technological instrumentations, engineering, and commissioning. The new PLTCM will have a rated capacity of 1.92 million t/year. The project is expected to be commissioned by July 2024.

Primetals Technologies

ASIA: INDIA

JSW places order for slab inspection and grinding plant

JSW has awarded Danieli Centro Maskin the order for the supply of a new slab grinding plant for its Dolvi, Maharashtra, facilities.

Structured in two phases, the project will start with the supply of a first grinding unit equipped with a 710-kW oil-lubricated spindle. With the installation of the second grinding unit (phase II), the SuperGrinder plant will reach an overall output of 1.3 million t/year. A newly designed edge grinding unit with double-grinding cart configuration will serve the two grinders. A latest-generation surface defect inspection system will make use of combined high-definition image acquisition and laser sectioning, with functions for automatic detection and classification.

The new slab inspection and grinding plant will be used to process ultra-low, low- and medium-carbon grades as well as alloy steel grades. Start of operation is planned for mid-2023.

Danieli

ASIA: INDONESIA

Launch of GIFA and METEC Indonesia

With the launch of GIFA and METEC Indonesia, two new platforms are emerging for the growing Indonesian metallurgical and foundry industries.

GIFA and METEC Indonesia will take place for the first time in Jakarta from 13 to 16 September 2023, providing Indonesia's metallurgy and foundry industries a new professional marketplace while granting international industry players access to an attractive future market. The organisers behind the new trade fairs are Messe Düsseldorf Asia (MDA) in Singapore, subsidiary of Messe Düsseldorf Group for the Southeast Asian market, and PT Pamerindo Indonesia, a leading trade fair organiser in Indonesia.

GIFA and METEC will cover a comprehensive spectrum of machines, plants and technologies ranging from additive manufacturing, foundry machines and processing plants to new technologies for user industries in various vertical markets – from the automotive industry, construction, the energy and gas sectors to users in metal works and steel mills.

The two trade shows will be co-located with the 20th edition of Mining Indonesia, organized by PT Pamerindo Indonesia. Together, the three trade fairs will form an integrated business platform for the supply chains in mining, metallurgy and casting.

Messe Düsseldorf

ASIA: SOUTH KOREA

Cheniere and Posco International sign LNG sale and purchase agreement

Cheniere Marketing has entered into a liquefied natural gas (LNG) sale and purchase agreement with Posco International. Besides being South Korea's largest steelmaker, Posco is also owner of South Korea's first private LNG terminal.

Under the agreement, Posco International has agreed to purchase approximately 0.4 million t/year of LNG from Cheniere Marketing on a free-on-board basis for a term of 20 years beginning in late 2026. The purchase price for LNG under the agreement is indexed to the Henry Hub price, plus a fixed liquefaction fee.

The agreement is subject to Cheniere making a positive final investment decision to construct the Corpus Christi Stage III Project. This project is being developed to include up to seven midscale liquefaction trains with a total expected nominal production capacity of over 10 million t/year.

Cheniere Energy, Inc. is a leading producer and exporter of liquefied natural gas in the United States, with capabilities that include gas procurement and transportation, liquefaction, vessel chartering, and LNG delivery.

Posco

ASIA: TAIWAN

Kocks establishes representative office

Kocks has opened a representative office located in the city of Kaohsiung, Taiwan, to expand the company's business and promote its internationalization.

The new representative office will promote and market Kocks products and services in the region, coordinating and establishing new business relations. The office allows advising and assisting customers on a new level. With Kocks experts working in Asia for Asia, common barriers due to geographic distance or time differences are eliminated.

Kocks

ASIA: VIETNAM

Hoa Phat expands steel plant

Hoa Phat Dung Quat Steel JSC has awarded a contract to Primetals Technologies for a new production line at the steel plant in Dung Quat, Quang Ngai Province.

The project consists of two slab casters, a hot rolling mill, modern automation systems, and comprehensive digitalization solutions to increase Hoa Phat's annual production by 5.6 million t. A fully integrated quality control system, intelligent digital assistants, and scheduling solutions will ensure high quality, productivity and flexibility. The start-up is expected for 2024.

Primetals Technologies is responsible for the design, engineering, and supply of mechanical equipment, media systems, technology packages, automation technology, and digitalization solutions for a fully integrated production route. The 2-strand casters will be designed as bow-type machines. With a rated capacity of 6 million t, they will produce slabs with a thickness of 230 mm ranging in width from 900 to 1,650 mm. The hot-strip mill with a rated capacity of 5.5 million t/year will produce strip from 1.2 to 25.4 mm thick and from 900 to 1,650 mm wide in coils weighing up to 36 t. It will comprise a slab-sizing press, two single-stand roughing mills, a seven-stand finishing mill, three down coilers and auxiliary systems.

Primetals Technologies

Erratum

We deeply apologize for the error on page 41 of our spring issue, STEEL + TECHNOLOGY 1/2022, regarding the authors of the article. Actually, this article was provided by the company VEM motors GmbH in Wernigerode, Germany.
We understand that this oversight may have caused confusion among our readers. Thus, we will take extra measures in making sure our dissemination of future articles is accurate.

STEEL + TECHNOLOGY editorial team

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Ironmaking

Trinec Iron and Steel Works to build new hot blast stove for its ironmaking complex

The new plant, designed by Paul Wurth, has an external combustion chamber that offers operational advantages

"The speed with which we intend to action this work is a reflection of its urgency. The new facilities must be erected in quite a restrictive space, meaning this project will face unique challenges for us to overcome."

Markus Bierod, Managing Director of Paul Wurth Wiesbaden

At Trinec Iron and Steel Works a hot blast stove at blast furnace No. 4 is to be replaced by a new one (Picture: Trinecké Železárny)

Czech steel company Trinec Iron and Steel Works (original Czech name: Trinecké Železárny) contracted SMS group's subsidiary Paul Wurth to construct a new hot blast stove (HBS) for feeding blast furnace No. 4 at its Trinec site in the Moravian-Silesian region in the eastern Czech Republic. The new facility boasts a state-of-the-art design, thus ensuring a high level of reliability, long service life, and far lower emissions compared to competing designs.

"We are proud to continue our relationship with Trinecké Železárny – a partnership that has a long history of trust built on the success of a number of previous projects," said Georges Rassel, CEO of SMS group Region Europe. "We hope to get the project underway quickly and are aiming for the new hot blast stove to be ready halfway through next year."

"The speed with which we intend to action this work is a reflection of its urgency. The new facilities must be erected in quite a restrictive space, meaning this project will face unique challenges for us to overcome," said Markus Bierod, Managing Director of Paul Wurth Wiesbaden, the SMS group entity commissioned to execute the order. This Paul Wurth-designed hot blast stove, featuring an external combustion chamber, represents the latest development in ironmaking technology.

Paul Wurth has collaborated with Trinec Iron and Steel Works in the past, most recently completing a project to reline blast furnace No. 6 in autumn 2021. This included coordination activities with the teams in Germany and locally in the Czech Republic.

SMS group

The new M-Series

New generation of highly efficient centrifugal fans

Highly efficient industrial centrifugal fans with impellers optimised for efficiency can reduce energy consumption and thus operating costs and also minimize environmental pollution. Furthermore, many countries impose mandatory energy efficiency guidelines. As a result of intensive research, Venti Oelde has introduced a new generation of a state-of-the-art impellers: the M-Series

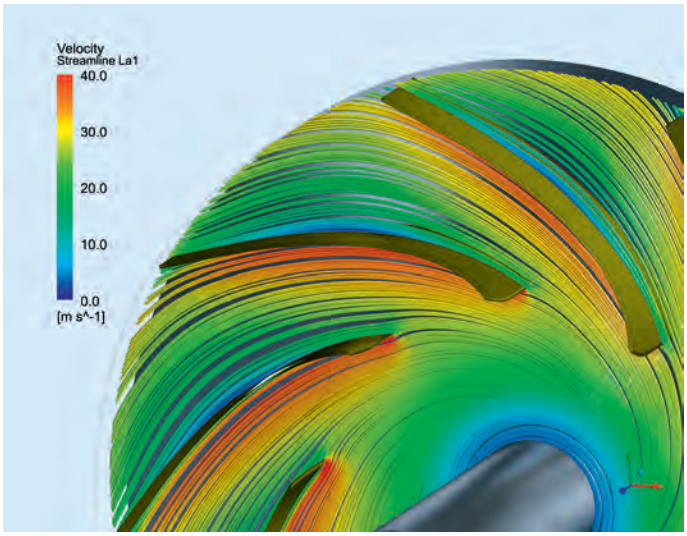


Figure 1. Flow line representation (Picture: Venti Oelde)

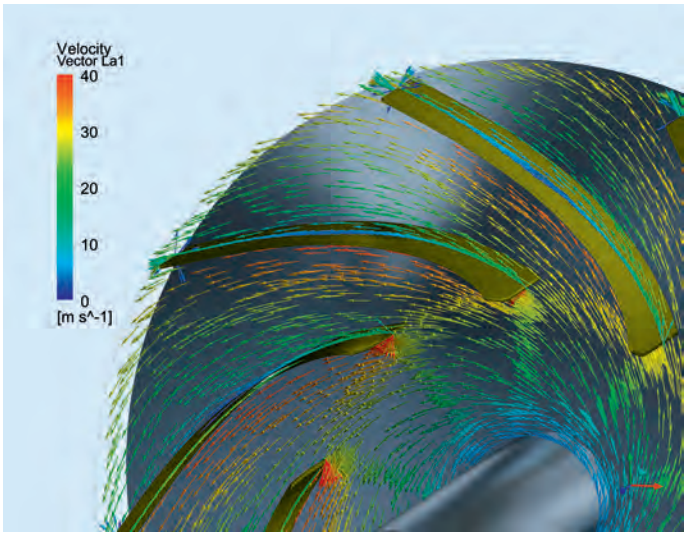


Figure 2. Vector representation (Picture: Venti Oelde)

Improvements in efficiency, which lead to reduced power consumption, are particularly noticeable in the case of large fans, whose impellers with diameters of up to 5 meters usually have a power consumption in the megawatt range. The intention is that lower power consumption will help protect the environment. It can be assumed that legal regulations will be tightened worldwide in the future. Last but not least, operating costs should be reduced in order to counteract rising energy costs. Furthermore, the behaviour of the impeller in an airstream with a high particulate content, e.g. in a cement works, is an important scenario and one which was considered when designing the new M-Series impeller. A conscious decision was taken to ensure users could replace just the impeller in existing Venti Oelde fans with an optimized impeller, while retaining all other original fan components, such as casing, shaft, inlet box, bearings, etc.

Design and optimization process

In order to be able to exploit fully the performance potential of the impeller, Venti Oelde developed the most advanced design process based on current state of the art for fully computer-assisted modelling of an impeller blade. The computer-modelled impeller blade makes it possible to calculate the impeller blade in advance, in complete detail, with any blade profile. In particular, the possibility of being able to freely select the contours of the blade, i. e. the curvature at any point along the blade, offers the developer much more freedom to optimize the impeller than with classic methods. Previously, the blade profile was specified as a line, radius or logarithmic function, the design options of which are far less flexible than the newly developed design method.

As the required specifications cannot be explicitly determined in advance, an iterative process is employed in which the impeller is simulated after the preliminary design with the help of computational fluid dynamics. The results thus obtained can be displayed both as a numerical value, such as pressure

Roland Magiera, Peter Herrmann, Ventilatorenfabrik Oelde GmbH – Contact: peter.herrmann@venti-oelde.de

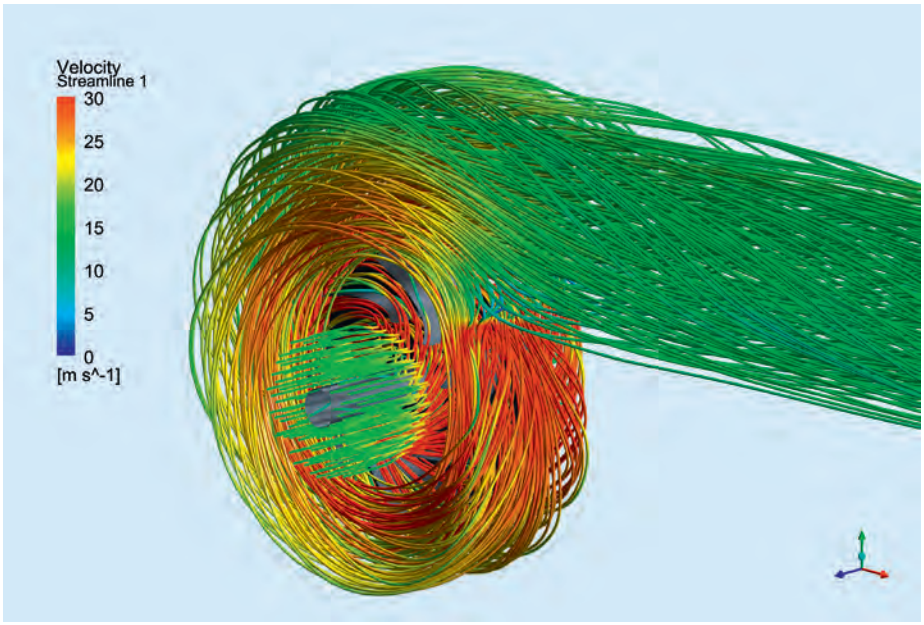


Figure 3. Flow line representation in the impeller casing assembly (Picture: Venti Oelde)

increase or efficiency, as well as graphically in the form of flow visualizations such as flow lines, vectors or pressure gradients. By comparing the results with each other and with the actual state during an optimization case, it is possible to obtain data about the progress of the development. The main goal of impeller configuration is to develop an impeller through which air flows with minimum turbulence, together with low-impact flow onto the blade leading edge and a uniform outflow at the impeller outlet. In addition to reduced power consumption due to high efficiency, this serves in particular to keep the deposits that are unavoidable in dust-laden flows as low as possible and to increase operational smoothness.

Today, flow simulations can model dust-laden flows. By comparing a flow simulation with particles with impellers in real operation in dusty airstreams, Venti Oelde was able to localize areas where deposits occur and to optimize the design selectively. Massive deposits occur particularly in areas of the impeller where the flow is subject to strong turbulence, and thus to drop of pressure and velocity, due to suboptimal flow control. Strong turbulence can induce localized backflows in the impeller; it has been proven that these are the areas most affected by deposits. During impeller development particular attention is given to achieving the lowest possible turbulence as well as a deposit-free flow through the impeller, especially in the particularly critical zones below the impeller blade, the so-called blade underside. The innovative design process of the M-Series offers a substantially wider range of options than previous processes. Optimization is considered complete as soon as the conditions relating to pressure increase, efficiency and flow behaviour are achieved and no further improvements can be made. According to the current state of the art, the resulting blade shape is, out of all possible large centrifugal fan blade shapes, closest to the ideal shape that is most favourable in terms of flow and operation. In the usual, cost-effective design with curvilinear blades with a linear leading edge, a total fan efficiency of over 90% is possible, using the new type of impeller blades.

Figure 4. M-Series fan in large-scale testing facility (Picture: Venti Oelde)

Presentation of the new fan blades

Venti Oelde's range of fans is currently being completely revised. This process will soon be completed. At the present time, several series have already been optimized. During our research, volute casings were analysed in addition to impellers. It was established that the existing Venti Oelde casings, which were designed based on an extensive series of measurements in cooperation with accredited university research institutions, do not offer any significant potential for improvement.

Since the outside dimensions of the optimized impellers are unchanged, it is possible to retain the casing, shaft and bearings when replacing the impeller, thereby achieving a significantly higher total efficiency with associated energy savings of 3 - 5%.

This can be clearly illustrated through the example of the HRV 63M Series, which is often operated as a cement mill fan with a throughput of up to 1,700,000 m³/h. The HRV 63M was one of the first models to be optimized and has been available since mid-2021. The use of the optimized impeller enables an increase in total

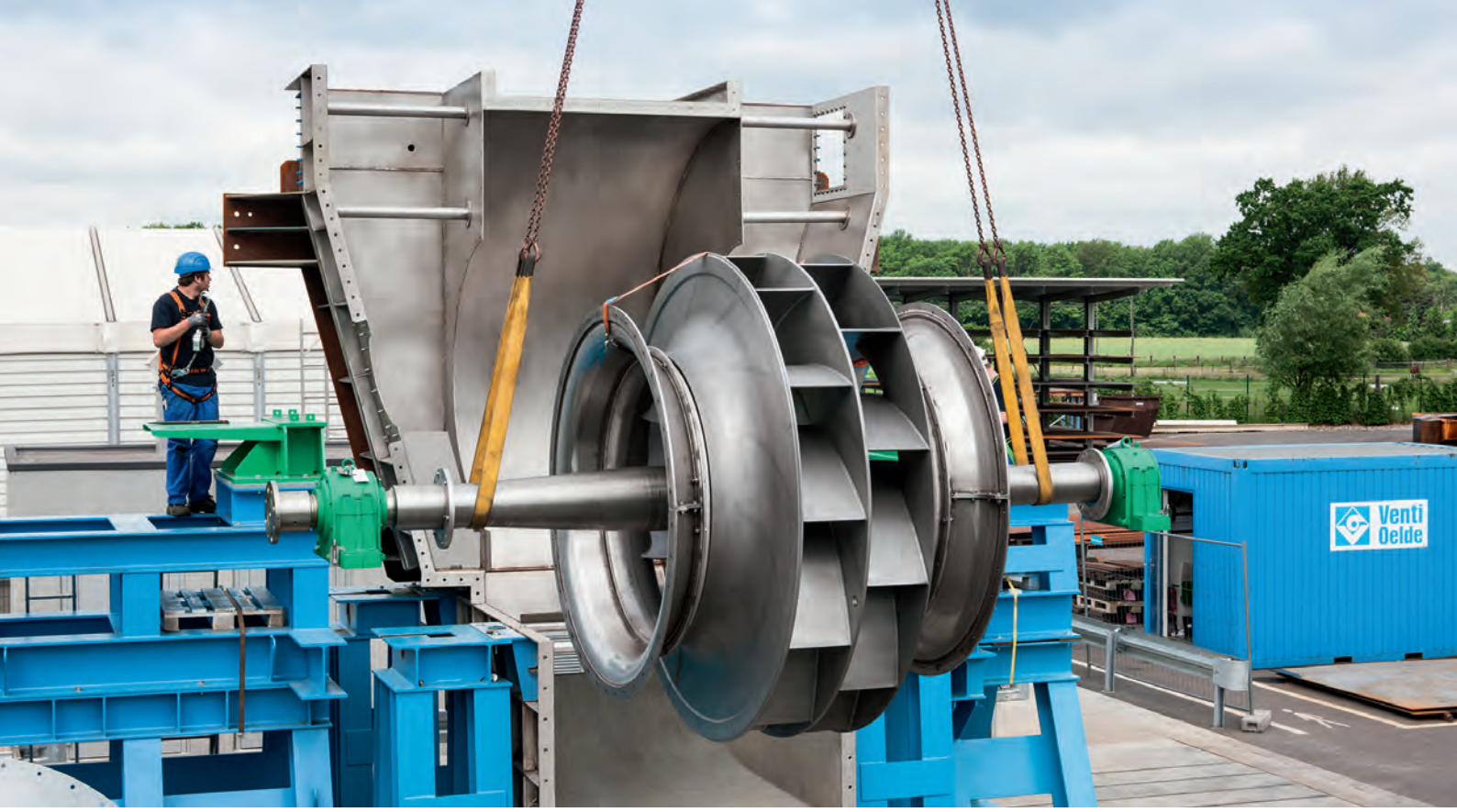


Figure 5. One of the first double-flow fans with the new M-series impeller blades (Picture: Venti Oelde)

efficiency of 4% compared to the previous model the HRV 63S. With a power consumption of 4,300 kW, this means a reduction in power consumption of around 170 kW.

Redesigning the impeller blade has significantly reduced flow turbulence through the optimized impeller. This is demonstrated by the shape of the simulated flow lines and vectors. Ideally, the relative component of velocity runs parallel to the blades, without causing flow separation. Flow separation partially blocks the channel, thus causing high-loss velocity peaks and an uneven flow onto the volute casing. In addition, separation increases deposits in a particle-laden airstream. The redesigning goal is therefore to create a low-turbulence impeller that offers both increased efficiency and fewer problems with deposits and abrasive wear. Of all the design methods, the computer modelled blade is most suitable for this purpose. The flow line and vector representation of the optimized impeller illustrates this impressively (**figures 1 and 2**). There are no flow separations within the impeller channel. The flow is blade-congruent, the impeller outflow is almost completely uniform. The drop in speed visible in the vector representation in **figure 2**, located directly behind the blade trailing edge, is technically unavoidable and is referred to in the jargon as trailing vortices.

Since flow simulations are extremely time-consuming and the existing Venti Oelde casings are already operating in the optimal range, research is initially conducted using only one impeller sector containing one blade. Once impeller optimization is complete, the new impeller is simulated in the volute casing (**figure 3**) to assess impeller casing interactions. If no unexpected events occur that lead to further optimization steps, development is considered to be complete. The prototype impeller is ready than for manufacturing and measuring in the test facility.

Standardization takes place after the impeller has been measured in the testing facility in all practice-relevant configurations, including one-sided bearing arrangement (overhung) or impeller between bearings and with or without a suction box. Afterwards, the fan can be designed and manufactured in all required sizes up to around 5 meters impeller outer diameter.

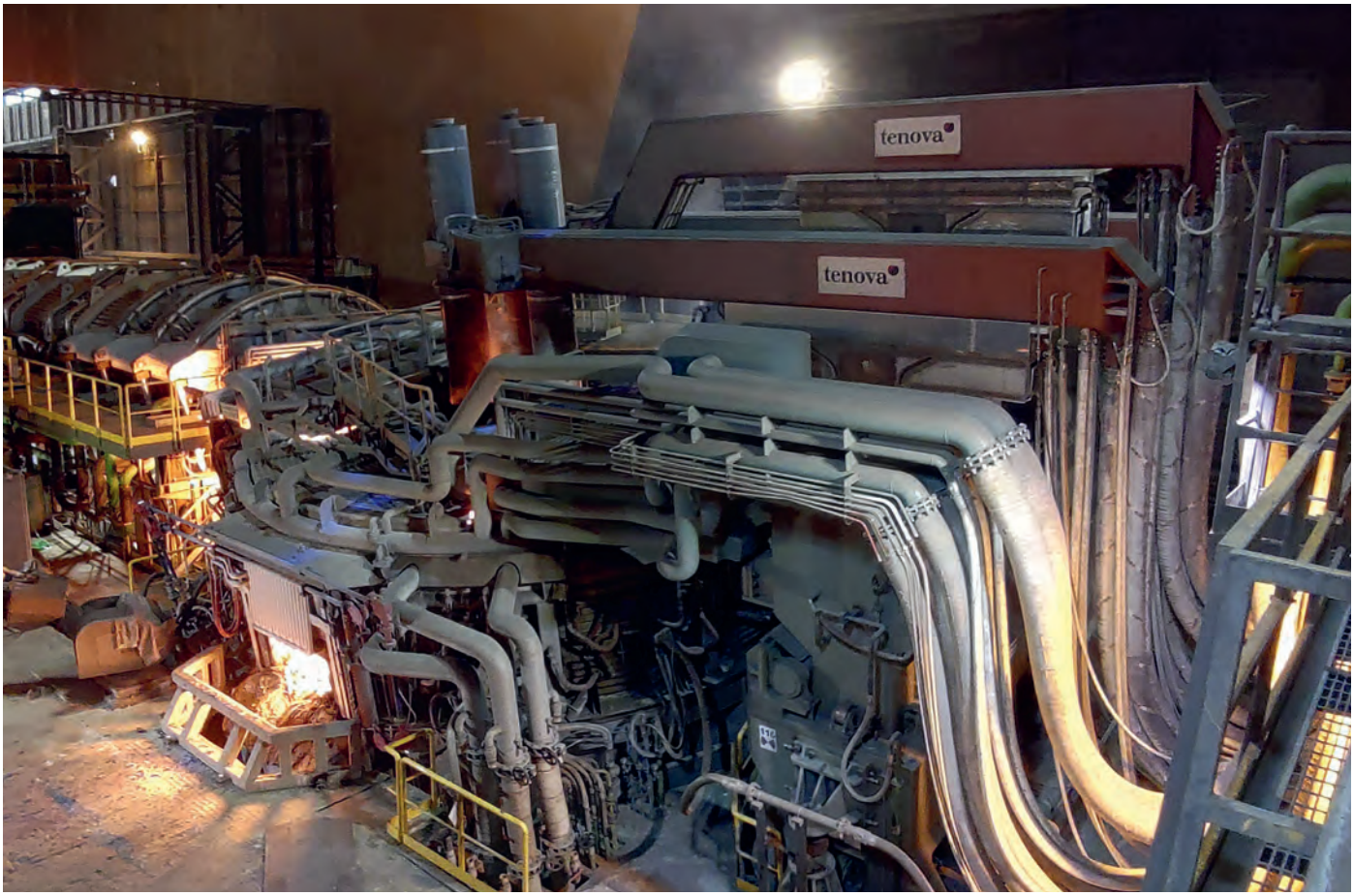
The HRV 71M-1600/K was one of the first fans featuring the new fully computer-modelled impeller blades to be measured in Venti Oelde's large-scale testing facility (**figures 4 and 5**). At its best point, this fan achieves a measured total efficiency of 90%, which is very close to the theoretically possible maximum for large fans with a broad bandwidth. According to current state of the art, noticeable improvements are only possible with considerably more complex impeller designs. For example, using 3D impellers with spatially twisted blades that are brought forward into the impeller inlet, which would massively increase costs. In addition, further problems with spatially twisted blades could occur, for example in partial-load operation, since they react more sensitively to turbulence.

Due to this and other influencing factors, emphasis was placed on design simplicity when developing the new impeller series. Due to the high degree of robustness achieved, mechanical problems, e.g. due to vibrations caused by caking arising from impeller use in dusty flows, can be minimized.

The testing facility measurements required for standardization of the new impeller series have also proven that the impellers designed according to the newly developed process create significantly lower noise emissions and offer improved running smoothness due to lower flow-induced vibrations. This increases both efficiency and the maintenance interval.

The first series incorporating the newly designed impellers have already been standardized. Others are currently being measured. This means that flow-optimized impellers from Venti Oelde's M-Series are immediately available to fan operators.

Venti Oelde



The new electric arc furnace at the Arvedi steelworks is again continuously fed by a Consteel scrap conveying and preheating system (pictured left) (Picture: Tenova)

Innovative charging and melting solution

Advanced electromagnetic stirrer on the large electric arc furnace at Arvedi

Application of electromagnetic stirring results in productivity increase and reduction in electrical energy consumption, but also in higher flexibility in the operation of the furnace and in the use of the raw materials mix with significant improvement of the metallic charge yield

Leading metals industry suppliers ABB and Tenova have obtained final acceptance from their customer Acciaieria Arvedi in Cremona, Italy, after partnering to deliver an innovative technology package, enabling optimal charging, melting and electromagnetic stirring for the world's highest-yielding EAF. The powerful solution combines a Tenova Consteel® EAF continuous scrap charging system with Consteerrer®, a model of the well-established ABB ArcSave® electromagnetic stirrer designed specifically for continuous charging EAF systems.

The record-breaking electric arc furnace has a 300-ton tapping size and utilizes a charge mix which include hot briquetted iron (HBI). It was installed to meet the demand for increased output following the recent revamp of the continuous endless strip production (Arvedi-ESP) casting and rolling mill line at the plant.

"We're really thankful for the seamless collaboration between Tenova, ABB and the Arvedi technicians and site personnel, and for the great efforts our teams have made during this world-class project. We're very proud of the contribution our technologies are making to Acciaieria Arvedi's ambitions as a steel industry trailblazer," said Silvio Reali, Tenova senior vice president.

"The metals industry is essential for the transition to a net zero world. Working together on this milestone project will support Acciaieria Arvedi to have one of the

most sustainable, efficient and modern steel operations," said Zaeim Mehraban, global sales manager, metallurgy products at ABB.

"We are already working with a modern plant based on Arvedi patented technologies, fulfilling productivity, technological, environmental, and safety objectives. An important achievement has now been reached on the melting side thanks to the work with our partners Tenova and ABB," said Andrea Bianchi, R&D director at Acciaieria Arvedi. "We are showing that it is possible to produce high-quality steel for our customers with the highest output from a single EAF, reducing the resources and the energy we need to use, and minimizing CO_2 emissions."

Acciaieria Arvedi chose Tenova Consteel® EAF for the second time in 2018, strengthening the plant supplied in 2008. The new installation, built to comply with the higher productivity of the recently improved continuous casting and rolling line, takes into account the requirement for increased productivity and operational flexibility, particularly in relation to the metallic charge mix that is of strategic importance in the EAF process.

The careful design of the equipment and the operational results achieved demonstrate the reliability of the technology involved and the validity of this approach for the safe production of steel with minimal environmental impact. The new electric arc furnace has a diameter of 9.1 meters and is continuously fed by a Consteel® conveyor and the latest generation of Tenova injection system. A plant of advanced and innovative technology, as demonstrated by the integration, since the beginning of the project, of the Consteerrer® system designed in collaboration between ABB, Arvedi and Tenova.

At the core of Consteerrer® is a unique, patented, non-contact electromagnetic stirring technology that has repeatedly been shown to deliver a wide range of metallurgical improvements. Site results confirm that the Consteerrer® electromagnetic stirring system has delivered a range of process improvements, thereby increasing EAF productivity, energy and resource efficiency at Acciaieria Arvedi. These include an 18 degrees Celcius lower tapping temperature and a 3.6 percent reduction in electrical energy consumption resulting in a 38,000-tonne annual reduction in CO_2 emissions at the plant. EAF productivity has increased by 5 percent and final oxygen content in the EAF steel has decreased by 17 percent. Other benefits can be seen in increased scrap yield, reduced electrode use, lowered refractory wearing, reduced carry-over slag while processing is more stable and final tapping conditions more easily controlled.

ABB / Tenova

Fossil-free rolling mill

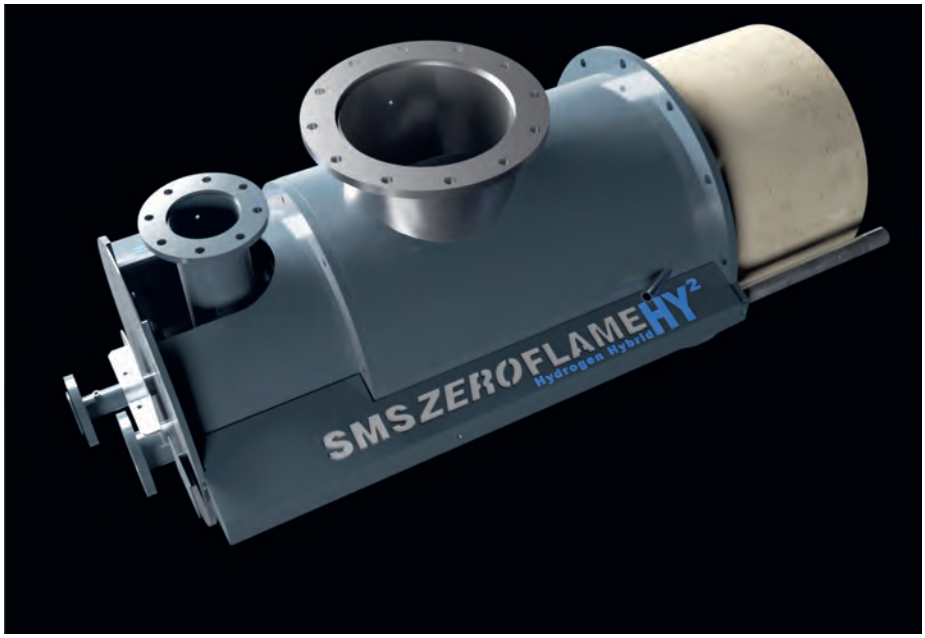
Environmentally friendly reheating technology for the production of steel bars

Megasider Zaragoza builds a „hydrogen-ready" merchant bar mill. Actually, the walking beam furnace is to be prepared for CO_2-neutral production using the HY2 flameless burners from SMS group

Megasider Zaragoza S.A.U., a company of the Megasa Group since 2016, has placed an order with SMS group for a merchant bar mill equipped with environmentally friendly reheating technology. The new plant will replace the existing rolling mill, which was delivered by SMS in 2005. The works is strategically located in the northeast of the Iberian Peninsula near Zaragoza, Spain, with excellent connections to major industrial areas in Spain and France. The production facility will be designed to manufacture a wide range of merchant bar products complementing and expanding the product portfolio of the company.

Megasider will be supported by SMS group in the approach of NG-free production and digitalization. As a systems supplier, SMS group will provide an overall concept for operating the flexible burners with a digital control system.

SMS' scope of supply includes a walking beam furnace equipped with the latest reheating technology for eco-friendly operation. Specifically, the furnace, based on a capacity of 120 tons per hour, will include SMS Prometheus® Level 2 control – ensuring uniform temperature distribution and low oxidation and carbon enrichment of the steel – as well as the SMS DigiMod combustion management system and SMS ZeroFlame HY2 burners. These extra-low-NO_x flameless burners are capable of operating with both natural gas and a blend of natural gas and hydrogen in any ratio, making this furnace hydrogen-ready.



3D image of the hydrogen-ready ZeroFlame HY2 burner from SMS group
(Picture: SMS group)

The combination of the SMS ZeroFlame HY2 burners, the DigiMod combustion management system, and SMS Prometheus® control will lower NO_x emissions to 45 ppm, reduce scale formation to 0.4 per cent, and cut fuel consumption to 27 Nm^3 per tonne of steel produced.

The scope of supply also includes a multi-strand straightening machine with automatic bar positioning and feeding device featuring automatic roll changing system, a cold saw to be used with either abrasive or metallic disks, and a RAM (rotating-arms automatic) magnetic stacker with four independently operating four-meter sections. The high-precision profile gauge with surface defect detection capability, supplied by TBK, a company of SMS group, will allow Megasider to perform contactless precision measurements for optimal bar production processes.

The whole plant will be controlled by the X-Pact® automation system, SMS group's level 1 and level 2 solution. This holistic approach aims to integrate the company's many years of experience in automation into the rolling process, with the goal of maximizing the plant's performance. At the same time, it also enables the immediate implementation of digital solutions based on harmonized data processing.

"We are proud that Megasider is relying on the future-oriented technology of SMS group and will obtain a plant that sets standards in the environmentally-friendly production of steel bars."

Luigi Barbante, Vice President Bar & Wire Rod Mills, SMS group.

SMS group

At VDM Metals the road-rail robot VLEX 20 automatically moves a 50-ton bucket charged with scrap to the meltshop (Picture: Vollert)

Shunting under rough conditions

Scrap transport with the smart road-rail vehicle VLEX

Heavy masses and efficient bulk loading without endangering people – the transport of scrap and metal presents many challenges. The shunting specialists at Vollert meet this requirement with the robustly designed shunting vehicle for road and rail. The compact VLEX vehicles are in use at two steelworks in Germany.

German steelmaker Elbe-Stahlwerke Feralpi (ESF) in Riesa, Saxony, has specialized in the production of high-performance steel products for the construction industry and infrastructure. Tons of scrap are regularly recycled here and transformed into billets, bars or mats of steel.

Once delivered to ESF, the rail cars filled with scrap must be unloaded as quickly as possible by excavator or crane, and the scrap proceeded to the production hall in Riesa so as to avoid blocking the rail through traffic there. In this process one employee is responsible for both the unloading and the shunting of the wagons.

Remote controlled shunting of the wagons

For this reason, Vollert provided the VLEX 40 road-rail vehicle for ESF. The maneuverable shunting solution for rail and road is not only able to move heavy weights but is also operated via remote control. At ESF, this shunting process is monitored by a logistician. First, the operator unloads the wagons prior to activating the VLEX 40 via remote control to move the freight wagons. To ensure optimal visibility at all times, Vollert equipped the shunting vehicle with a camera system for the first time. "The camera image is shown on the display of the RC device, similar to the rear view camera in a car. This guarantees a clear view when the VLEX is in motion," explains Michael Spohn, project manager sales at Vollert.

Fast and safe change of location

The VLEX 40 moves the 500-ton rail cars without any effort: With a towing force of over 40 kN and a dead weight of 10 tons, the road-rail robot is suitable for heavy materials weighing up to 600 tons. Its sophisticated vehicle geometry with articulated steering and four individually controlled wheel hub motors ensure that it makes the change from track to road particularly maneuverable and economical. Hydraulically lowering track guide rollers for rail travel and an oscillating axle guarantee continuous ground and rail contact for all four wheels, regardless of the surface. "In other words, the VLEX can change or leave the tracks at any time, which are thus free again for through traffic after a short time," says Marco Kießling, head of scrap control at ESF, summarizing the advantage as another benefit.

The robust VLEX 20 is equipped with impact protection against falling metal parts
(Picture: Vollert)

Transports to the meltshop at VDM Metals

Vollert has also found a solution in terms of intralogistics for VDM Metals, a German manufacturer of corrosion- and heat-resistant high-performance materials located in Unna in North Rhine-Westphalia. Nickel-base alloys and stainless steels are produced here from both, recycling and virging metals in an electric arc furnace. Cast to ingots and blooms, the downstream mill produces sheets, strips, bars, forgings and wires.

VDM Metals was looking to make the in-plant shunting of scrap baskets more efficient and flexible. Previously, a rail-based shunting vehicle equipped with an additional trailer for a second scrap basket transported the material to the EAF. "However, the transport equipment, which was getting on in years, was now proving to be particularly prone to breakdowns," reports Uwe Neuhaus, project manager maintenance at VDM Metals. "The high level of maintenance regularly led to stoppages on the 40-m-long track. Therefore, Vollert was originally supposed to design a similar new vehicle for us." But the engineers had a more cost-effective combination in mind with the VLEX shunting robot and two transport carriages. "The carriages should remain rail-based, while the shunting vehicle should be flexible," says Michael Spohn, clarifying the idea. "In this way, the VLEX also offers the possibility of taking over further transport tasks in the operation aside from the rail track."

Focus on towing force and impact protection

The strong tractive force and robustness of the VLEX 20 also pays off in this transport operation: First, the two buckets are loaded with scrap parts by a crane with an electromagnet. The VLEX 20 then moves the two transport carriages to the meltshop, where another crane empties the buckets and puts them back again. In total the VLEX 20 moves 100 tons – 50 tons per bucket. There is even further room for

At ESF the VLEX 40 handles the shunting of rail cars weighing up to 600 tons
(Picture: Vollert)

improvement here, as the VLEX 20 has a tractive force of up to 300 tons. To be able to move such loads, its manufacture must be particularly robust. This means that even the high dust levels in the meltshop cannot harm it. In addition, it has been provided with impact protection against falling objects. The vehicle itself does not contribute to further pollution or hazards: Thanks to its exhaust-free electric drive, it can be used in enclosed storage and production areas without any problems.

Due to the defined on-site pathway, the VLEX travels automatically. Control is possible from three stationary control panels – at the loading point, at the unloading point and on a meltshop bridge. A scanner on the VLEX continuously monitors the travel paths and stops the vehicle if foreign objects are detected, such as metal parts or scrap lying around. Intra-plant movement of persons or traffic is controlled by a traffic light system during travel.

Vollert Anlagenbau GmbH

The VLEX 40 road-rail robot is equipped with a camera system for convient remote control (Picture: Vollert)

Record-breaking dimensions

Long steel products of superlatives: thinnest wire rod and thickest round bloom

Saarstahl produces the thinnest wire rod in Europe with a diameter of only 4.5 mm. As a counterpart to this, the world's largest round bloom produced on a curved casting machine in China has a diameter of 1.2 m

The 4.5 mm wire rod is produced at the Burbach rolling mill on the four-strand wire rod mill (Picture: Dirk Martin/Saarstahl)

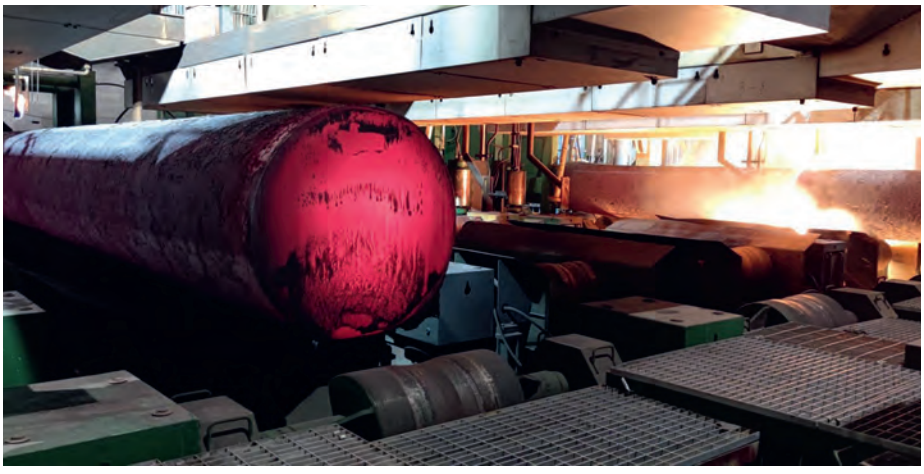
At just 4.5 mm, Europe's **thinnest wire rod** comes from Germany: The wire is a new addition to the Saarstahl AG product portfolio and is used for things such as rope and spring wire in the automotive industry and in mechanical engineering.

"With our new wire rod we are offering our customers a dimension that is the only one of its kind in Europe," says Dr. Klaus Richter, Chief Technology Officer of Saarstahl AG. "This positions us once again as one of the leading manufacturers of drawing grades." The wire rod is 33% thinner over the surface compared to standard 5.5 mm wire. One advantage the thinner dimension has over wider wire rod dimensions is that it eliminates the need for intermediate annealing of the wire. This cuts production costs during further processing. The material also does not become brittle due to the low drawing loss and thus has greater formability under load without breaking.

The 4.5 mm wire rod is produced at the Burbach rolling mill on the four-strand wire rod mill, one of the most efficient plants in the world. 550 employees produce up to 1.2 million tons of wire a year at the plant. "We are pleased to be able to offer our customers another dimension at an unrivaled level of quality with this new superthin wire rod and to expand our product range," said Tom Niemann, Chief Sales Officer of Saarstahl AG.

The world's **largest round bloom** ever produced on a curved casting line, with a diameter of 1,200 mm, comes from the city of Zhang Jiagang in the Chinese province of Jiangsu. On 26 March 2022, Italian plant manufacturer Danieli and Chinese steel producer YongGang commissioned the world's largest round section on curved conticaster with an 18 m radius here. Two of the four strands cast 1,200-mm diameter blooms, while the other two strands were equipped to cast 1,000-mm diameter rounds.

Based on Danieli experience collected in large round casting, the caster makes extensive use of electromagnetic stirring systems (mould, strand and final) for best internal quality with very low values of carbon segregation and central porosity, for a wide range of steel grades. The combined application of liquid-pool control solidification and wide battery of high-force withdrawal and straightening modules ensure smooth product unbending to maximize the results for surface quality and safe, reliable operation.



Semi-continuously cast 1,200 mm dia. round bloom at YongGang (Picture: Danieli)

Saarstahl/Danieli

Advanced quality assurance at voestalpine tubulars

Surface inspection directly downstream of the stretch-reducing mill

With simultaneous determination of wall thickness, diameter and profile, temperature as well as surface defects at the same measuring point, with the same pipe length reference, the surface inspection has moved one step closer to the manufacturing process

> "The perfect surface finish is an essential characteristic for a high-quality product, in addition to the measurement of the outer diameter and the wall thickness."
>
> *Thomas Brunner, assistant production manager tube rolling mill at voestalpine Tubulars*

Another milestone in the synergetic business relationship between IMS Messsysteme GmbH, Heiligenhaus, Germany, and Austrian tube manufacturer voestalpine Tubulars was recently reached: Potential surface defects on the hot-rolled finished tubes are now detected directly downstream of the stretch-reducing mill, bringing their detection another step closer to the manufacturing process.

With this success, voestalpine Tubulars once again distinguishes itself as a pioneer in the production of seamless rolled tubes. In terms of quality, the Austrian company repeatedly relies on the proven measuring technology of IMS and sets new standards in the industry.

What makes the joint project so special and in line with voestalpine's motto "one step ahead" is the combination of two completely different measuring technologies in a single system. For this purpose, the radiometric components of the existing 4-channel measuring system were mounted together with the camera and laser technology of surcon 3D surface inspection in a new housing that is only slightly larger in terms of dimensions. The advantages of this revolutionary fusion of two complex technologies are obvious:

- All measurement data such as wall thickness, diameter and profile, temperature and surface defects are determined simultaneously at the same measurement location and have the same tube length reference.
- The existing IMS measuring location can continue to be used as before.
- There is no need to create additional space for another measuring point.
- Only minor adjustments to the roller table elements and their surroundings are necessary.

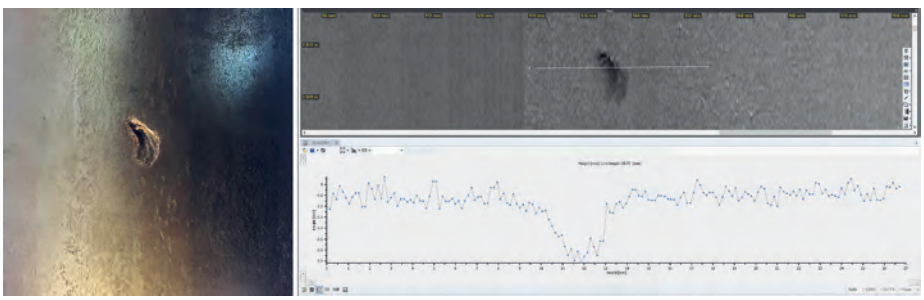


Photo (left) of the visible defect "impression" and measurement data (right) of the inspection system (Pictures: IMS)

The feedback from Kindberg is consistently positive and confirms to IMS Messsysteme GmbH the complete fulfillment of the customer requirement: "It is impossible to imagine everyday production without the surface inspection system after only a short learning phase. From our point of view, the surface finish is an essential component, in addition to the outside diameter and wall thickness measurement, to produce a high-quality product", says Thomas Brunner, assistant production manager tube rolling mill at voestalpine Tubulars.

The response time to eliminate the source of defects on the aggregates, such as buildup on the rolls of the mill stands, can be significantly reduced as well as the scrap rate. "The new surface inspection system from IMS saves us from performing production steps we don't need." The location and type of detected surface defects can be immediately communicated to downstream production areas. If serious defects are detected, which inevitably lead to rejects during quality control, the subsequent production steps can be avoided. Periodically occurring defects on the tube surface defects are reliably detected, identified, and can be quickly eradicated.

Thus, a technical upgrade of an existing tube wall measuring system, which is an economically highly interesting option for all PQF and FQM mill operators and users of 2-, 4, 9- or 13-channel wall thickness gauges from IMS Messsysteme GmbH.

The earliest possible detection of surface defects will be an essential requirement in seamless tube production in the future. Even today, high-precision measurement technology can no longer be ignored without having to call the highest product quality into question.

IMS Messsysteme GmbH

Quality in hot and cold processes

EMG completes the range of measurement and control systems for the metals industry

Rising demands in new materials and ever more complex components require increasingly higher process reliability in areas such as steel strip production. The Elexis Metals Business Unit and its EMG brand support the optimization of the individual production steps in hot and cold processing by installing high-precision measurement and control systems

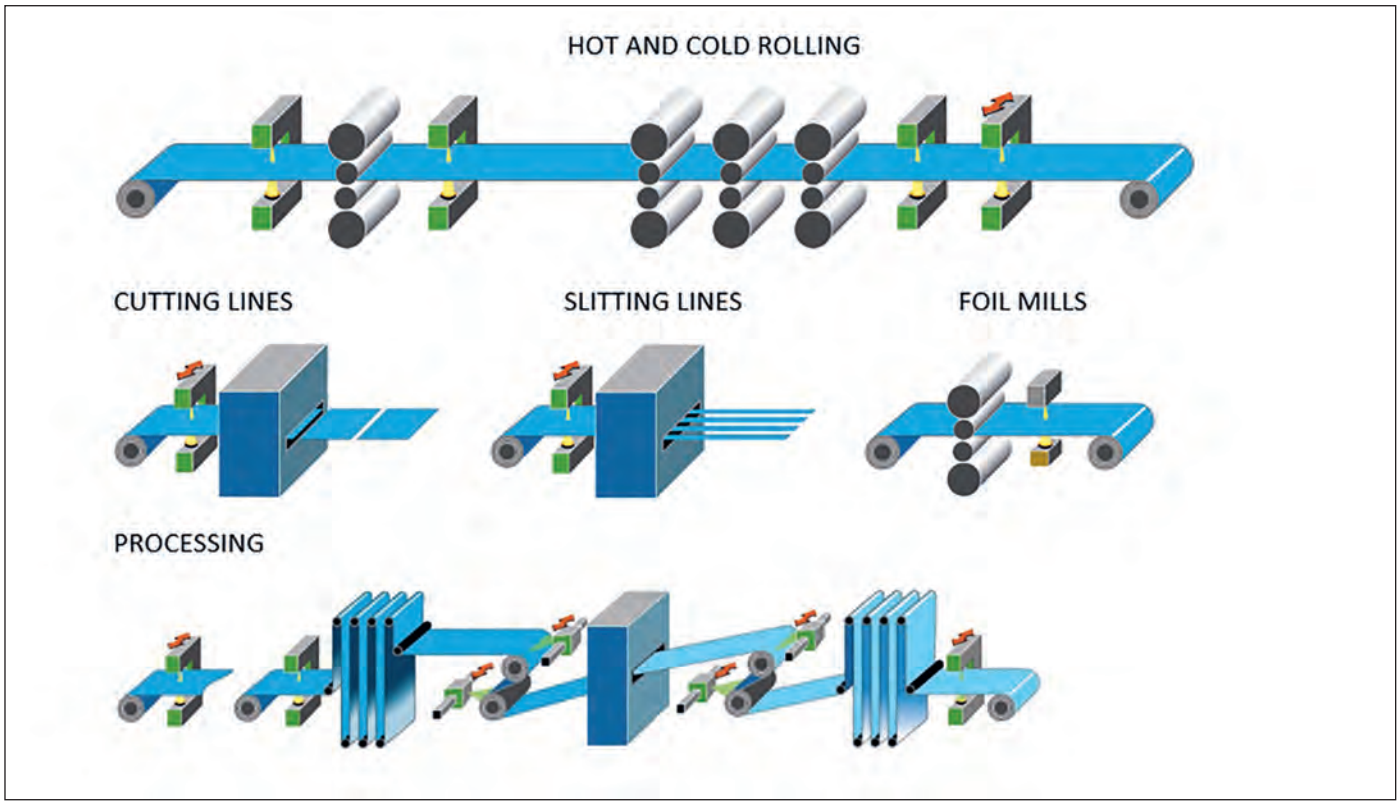
Worldwide, EMG measurement and control systems help to optimize hot and cold process steps in strip production, avoid rejects, reduce material costs and achieve higher quality. In combination with the quality assurance systems, high-precision strip guiding systems provide high line efficiency and high product quality. In the production, treatment and processing of flat steel products, the guiding systems ensure that the strip runs evenly and smoothly through the various production stages, preventing the products and the production equipment from being damaged.

In almost every process step, the EMG quality assurance systems can be used to identify strip geometry parameters such as strip thickness and width. Furthermore, the systems ensure precise online measurement of material properties, such as strip roughness and, in case of ferromagnetic steel strip, tensile and yield strength. Another field of competence of EMG is the online oil layer measurement during strip production and processing. The measurement and control systems of EMG are the result of a successful combination of proven hardware and software for easy and customized integration into existing production lines.

Since 2022 the company's product portfolio of quality assurance systems has been enlarged by non-contact thickness measurement solutions. These thickness measurement systems are used, e.g., in flat rolling mills to control the quality of products for different applications in the steel, aluminium and automotive industries.

Wide product range for challenging processes

High-precision, fully automatic online thickness measurements require a high degree of technological competence in a



Elexis' full-liner spectrum of measurement and control systems in hot and cold processes (Picture: Elexis)

EMG iTiM thickness measurement system in operation (Picture: Elexis)

wide range of applications. For a customized solution to be successful in a specific application, deep understanding of the specifics of the application and consideration of the respective accuracy requirements are needed. Laser measurement systems, for example, are easy to use, but have physical limitations in terms of absolute measurement accuracy. Here the comprehensive solution expertise of the enlarged EMG team, based on decades of experience, comes into play. In terms of technology, this expertise shows in the application range of the EMG iTiM sensor family.

EMG iTiM iso. The isotope radiation-based measuring system EMG iTiM iso works with different isotopes depending on the field of application and is used in both hot and cold processes. The flexible system design enables both single-point measurement systems and complex thickness profile measurements.

EMG iTiM xray. This system uses the high-precision X-ray thickness measurement method. EMG iTiM xray can be used with a wide variety of materials due to the different generator voltages. From wafer-thin foils to thick strips. Here, too, single-point measurements and high-resolution thickness profile measurements are possible.

EMG iTiM laser. The EMG iTiM laser optical thickness measurement systems are characterized by low complexity, compact space requirements and flexible integration into the production line, which represents an economical alternative to more complex and costly system solutions, especially for steel and aluminium service centres and automotive lines.

Based on its broad portfolio of strip guiding and quality assurance systems, EMG offers the most comprehensive spectrum of quality assurance systems worldwide for all stages of flat product production and processing.

Modular system with potential for line modernization

The modularly designed EMG systems provide additional advantages: Each installation is configured specifically for the individual line and equipped with a combination and design of sensors optimized for the specific application. Therefore, the systems are suitable as reliable solutions for the entire process and for individual production steps, as required.

The modular principle and the comprehensive product range of measurement and control systems provide a reliable basis for the modernization of existing plants and units. The EMG systems can be easily integrated into the user's automation environment. EMG's extensive experience obtained in a large number of industrial applications supports fast system integration into various processes. The fact that hardware and software come from a single source significantly reduces the user's need for spare parts and training. Due to EMG's application know-how, existing systems can be upgraded in a highly efficient manner because EMG has the application know-how to ensure optimized reuse of system components in a retrofit or modernization. Consequently, the high-precision measurement and control systems from EMG are always tailor-made and economic solutions for the respective application.

Elexis AG

Towards filler-less painting

Inline waviness measurement of electrolytic galvanized steel strip

As automotive producers are placing increasingly quality demands on the surface area profile of electrolytic galvanized strip, there is a growing need for steel producers to measure the surface waviness, in addition to the surface roughness. thyssenkrupp Steel Europe AG has been using the waviness measuring system from Amepa in an electrolytic coating line. This line is the first worldwide that measures the waviness along the entire strip length and width inline during running production.

A growing trend in car body shell painting is to apply the final coating directly on the electrolytic galvanized zinc layer, without a filling layer. Consequently, surface area profiles of just a few µm have moved increasingly into focus. In addition to the roughness, the waviness determines the visual appearance of the painted surfaces of car body shells and the overall look of a car. The waviness may cause undesired effects, such as orange peel.

While reliable inline measurement of the strip roughness has been possible for quite a long time, the Wsa values, which measure the waviness, have been determined offline, randomly, and only via samples taken from the finished coils. The threshold between "good" and "bad" quality is often determined based on an indirect relationship between two parameters. To this end, the parameters roughness (Ra) and peak count (Rpc) are set within defined limits and controlled to achieve a Wsa value in compliance with the specification.

However, as automotive manufacturers increasingly demand low Wsa values, it can be anticipated that specific waviness values will soon become a binding requirement of orders from the automotive industry.

A linear drive traverses the sensor across the entire strip width (Picture: Amepa GmbH)

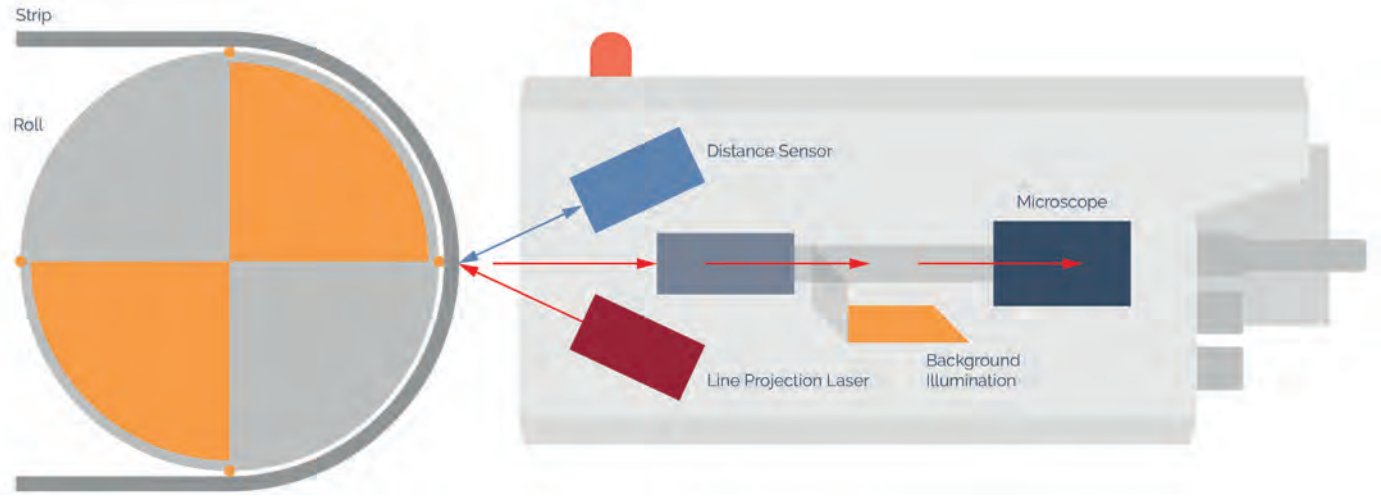
The aim

Therefore, thyssenkrupp Steel Europe (tkSE) was looking for a direct waviness measuring solution that would measure not just certain spots of the strip but also the entire surface over the entire strip length and width in real-time during production. A waviness measuring system should allow the operators to intervene immediately if certain tolerance limits are reached.

At that time, Amepa was just about to launch its new waviness measurement system. The system was developed based on Amepa's surface roughness measurement system (SRM system), which was already successfully in use at tkSE and other steelmakers' facilities. Therefore, it suggested itself to test the new system under operating conditions. tkSE's electrolytic galvanizing line EBA 3 in Dortmund was to be the company's first facility to use the new system.

A main reason for this decision was the fact that the data measured by the new system could be directly compared with the roughness control data from the downstream process stages because the roughness measurement (Ra) and the peak count (Rpc) systems are already in use, operate on the same basis, and use compatible data formats. This paved the way for a holistic approach to quality control based on objective data, taking various processing units along the production chain into account.

Dr.-Ing. Marc Blumenau, Frank Panter, thyssenkrupp Steel Europe AG, Dortmund, Germany; Dr.-Ing. Wolfgang Bilstein, Ansgar Berlekamp, Amepa GmbH, Würselen, Germany – Contact: ansgar.berlekamp@amepa.de



The laser (red) projects a line onto the strip. The line appearing on the strip surface is captured by the camera (black) with microscopic resolution (Picture: Amepa GmbH)

From roughness to waviness

For developing the waviness measuring system (WMS), Amepa expanded its optical roughness measurement system SRM with a waviness measurement feature. The new system can now simultaneously measure the roughness and the waviness with one common sensor.

The inline roughness measurement with the SRM system is based on the laser light-section process, a two-dimensional laser triangulation method. In this non-contact process, an extremely thin laser line is projected onto the strip surface at a specific angle. This line is captured by an integrated camera with microscopic resolution. From the line's contour, image processing algorithms calculate the surface profile.

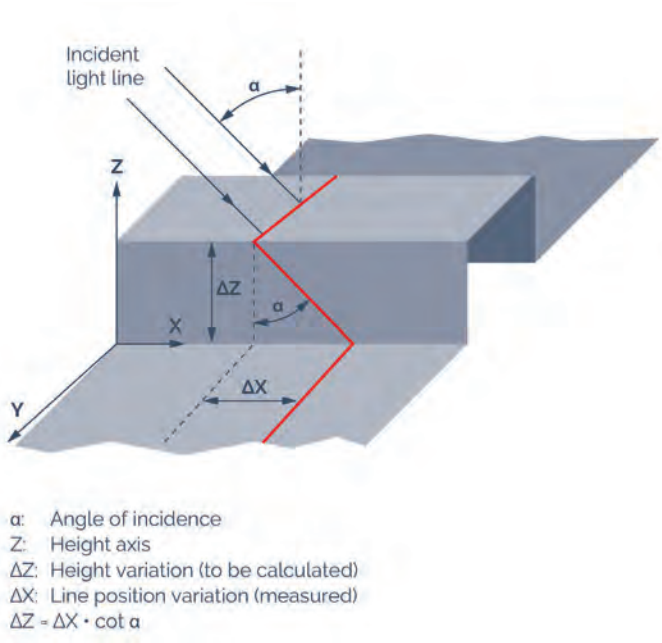
The measuring sensor is much smaller than the head of comparable roughness measuring systems because it contains only one camera on the receiver side. The measuring principle works with any surface condition. The head is arranged next to a deflector roll over which the strip runs. To ensure correct evaluation, the algorithms take into account the roll diameter.

While for a roughness measurement, the laser line usually runs transversely to the rolling direction, the laser line for the waviness measurement runs lengthwise in the rolling direction.

The high-speed camera takes 30 to 50 microscopic images of the laser line in rapid succession. It combines the individual images one after the other with a small overlap into an overall picture of the height profile. The rate at which the pictures are taken is synchronized with the strip speed. Thus, the individual images can be precisely assigned to the positions on the strip. In this way, a virtual laser line is created on the strip surface. The line covers several stretches of the one to five-millimeter-long waves. From this, the height profile in the rolling direction, and thus the Wsa value, can be derived. Another important aspect is that those picture elements have a fixed reference point to one another. This ensures that indefinite or missing data points can be interpolated.

The project

A sensor was arranged in place of an existing coating thickness measuring system facing a deflection roll in the line run-out of EBA 3. The existing structure was modified to accommodate the new traversing unit and decouple the system from the line vibrations. The new system was officially commissioned in October 2021. Since then, the system has been operating with great reliability. This makes EBA 3 the world's first electrolytic galvanizing line operating with an integrated inline waviness control system.



The light section principle: The laser light hits the strip surface at a certain impingement angle. The camera captures the laser line's offset (Picture: Amepa GmbH)

At the same time, the system still delivers the data needed for roughness control. All of the acquired data is continuously recorded and visualized on the control screen. If a roughness threshold is reached, process intervention is instantly triggered. Since December 2021, the roughness values have additionally been used to support ship/no-ship decision-making.

The reliability of the roughness control is verified by daily manual tactile measurements of samples taken from the strip and compared with the inline measurements of the corresponding strip locations. To verify the waviness measurements, a procedure for the analysis of the samples and the comparison with the inline data is currently being developed in cooperation with a certified testing lab in Dortmund.

First experience

The new system has considerably enhanced the effectiveness of quality assurance: The random analyzes in the downstream lab are now complemented by continuous inline quality control. If necessary, corrective action can now be taken immediately, without having to stop the production process. It is possible to influence the surface roughness and peak count, for example, by adjusting the dissolution conditions of the zinc anode.

According to the quality assurance personnel, the new system is "a gift". In addition to facilitating daily work, it also helps in quality decision-making. Even now, the Ra value is used for target/actual comparisons to support coil quality assessment and ship/no-ship decisions.

The availability of additional information about the roughness and waviness distribution over the entire strip length and width provides a host of new possibilities for further surface quality enhancement and making the strips suitable for filler-less painting. The new data form an essential building block to the digital, smart coil because more data is now available about an important surface quality parameter.

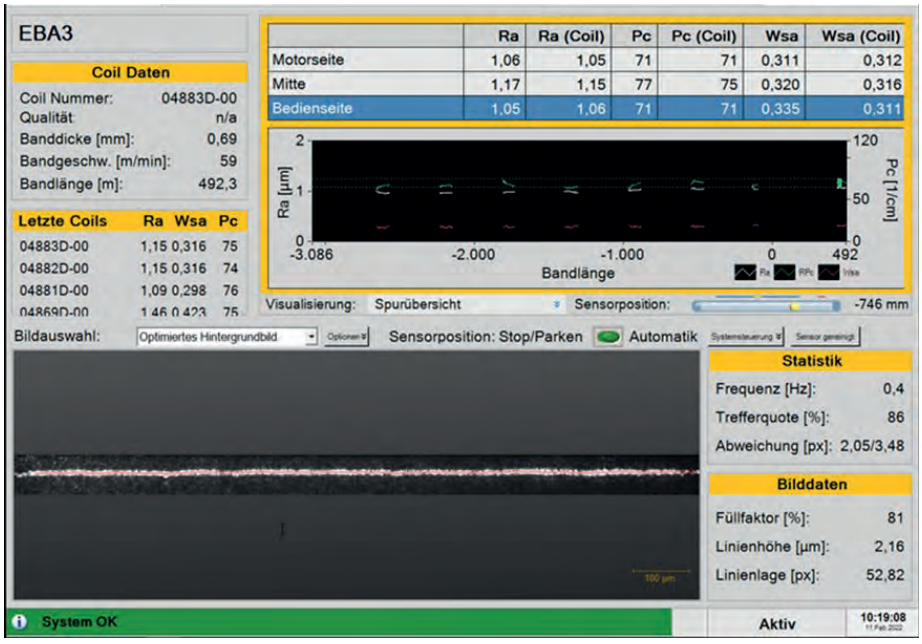
The future

Even now, it is evident that waviness specifications will become a standard requirement of customer orders in the years to come. Very soon, more and more orders from automotive producers will include a guaranteed specific Wsa value for the strip producers to comply with. Inline control of the waviness will then be indispensable. Thanks to the new measurement system, tkSE has what it takes to comply with this requirement.

The move away from random offline checking of the Wsa value to a continuous inline process provides many more important benefits: It is now possible, for example, to correlate the waviness values with the conditions in the various process stages, such as the cold rolling mill, the continuous annealing line and the EBA 3 itself. This will make it possible to provide answers to many open questions: How do certain conditions in the downstream process stages interact? Do they lead to positive effects, or do they aggravate negative effects? Do they complement each other, or do they have a neutralizing effect?

Thus, the WMS opens up a range of new opportunities for the examination of root causes for variations in surface waviness. Knowing the influencing factors along the process chain means that it will be possible in the future to precisely control the waviness – based on objective data, not on subjective judgment.

The sensor is arranged in the run-out section of the electrolytic galvanizing line
(Picture: thyssenkrupp Steel Europe AG)



Both the Ra and the Wsa values are displayed on the control screen
(Picture: Amepa GmbH)

Amepa, thyssenkrupp Steel Europe

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Klöckner & Co acquires Hernandez Stainless and RSC Rostfrei Coilcenter

The acquisitions of Hernandez Stainless GmbH and RSC Rostfrei Coilcenter GmbH through Klöckner & Co's German subsidiary Becker Stahl-Service mark Becker's entry into stainless steel processing.

Hernandez provides surface machining and stocks stainless flat products. RSC is specialized in stainless steel coil cutting. Both companies operate extensive machine facilities throughout Europe and supply around 400 distributors as well as stainless steel processors in various industries. RSC is also a major supplier to Hernandez. The transactions and the resulting product and service portfolio extension strengthen Klöckner & Co's position as a digital one-stop shop platform.

Klöckner & Co

thyssenkrupp Materials Processing Europe in El Puig to be climate-neutral by 2023

As part of the steel service center network of thyssenkrupp Materials Processing Europe, the site in El Puig, near Valencia, is systematically taking further steps towards climate neutrality.

By 2023, the company will operate on site in a climate-neutral manner. One important element is the installation of an extensive photovoltaic system. The first 525 solar panels have already been installed to make the most of the around 300 powerful days of sunshine in the region around Valencia. The electricity generated by seven inverters already covers 35% of the site's energy requirements. The installation of a further 1,300 solar panels will be completed next year. The company will then be producing solar power equivalent to the full amount of its own needs at the site, as well as additional energy from solar power that will benefit other consumers in the regional supply system. This will make El Puig the first operating site of thyssenkrupp Materials Services to operate on a climate-neutral basis.

However, the company's approach to sustainability goes beyond its own processes: As a member of the Responsible Steel initiative, the team at El Puig is committed to the increasing use of CO_2-reduced material. In addition, the site is committed to the reforestation of the forest on la Platà mountain in El Puig and supports the FEDA Madrid foundation and the Starkid School in Kenya as part of its training collaborations.

thyssenkrupp Materials Services

Outokumpu introduces new sustainable stainless steel

Outokumpu has launched a new emission-minimized product line, Circle Green, which has a significantly lower carbon footprint than the global average, according to ISSF calculations for stainless steel industry mean emissions.

Outokumpu achieved the emission reduction with improvements throughout the whole stainless steel production chain. Reductions in upstream raw material emissions were key to this success as they contribute the majority of stainless steel's total carbon footprint. Meticulous production and quality optimization led to higher energy efficiency. Biogas, biodiesel, bio coke, and low-carbon electricity have been used in production to eliminate 95% of all scope 1 and 2 CO_2 emissions. While these bio-based materials have all been tested previously in production, they were used together for the first time ever to produce Outokumpu Circle Green.

The material was produced on an industrial scale with Outokumpu's existing production assets. Outokumpu reviewed and optimized the emissions from each production step from the stainless steel melt process and energy production to transportation and raw material production. The emission reduction calculation includes all emission scopes according to the Greenhouse Gas Protocol method to give the full picture of the emissions. Climate compensating or offsetting has not been used in calculating the emissions and the focus has been on improving Outokumpu's own processes and supply chain.

Outokumpu

ArcelorMittal Europe launches new crane rail grade

ArcelorMittal Europe – Long Products' business division Rails & Special Sections has launched a new crane rail grade for heavy loads, allowing customers to optimise their life cycle cost.

Designed in ArcelorMittal's Rail Excellence Center (Global R&D), the new grade, R340, combines optimum process parameters with ad-hoc chemical composition. It was specifically designed with higher mechanical properties and hardness. A specific wear test was designed to assess in-service performance. The results show that R340 is benchmark in wear resistance thanks to the customised microstructure. Its mechanical properties include: hardness > 340 HB, tensile strength > 1,150 MPa, yield strength > 600 MPa and elongation > 7%.

Approved also for welding by usual methods the R340 is now integrated in the ArcelorMittal crane rails technical specifications and available on the entire crane and special rails range. "It has been a challenging development due to the ambitious hardness target to be achieved by natural cooling, but with this grade we have gone beyond the limits of the air-cooled pearlitic rail steels, "concludes Frédéric Goujon, product manager crane, grooved and light rails.

ArcelorMittal Europe

thyssenkrupp Schulte introduces new tool to enhance supplier search

thyssenkrupp Schulte has developed the Supplier Network Tool, a web-based database that enables its employees to connect with processing providers and request services with just a few clicks.

The database provides direct access to a comprehensive cross-border supplier network with an ever-expanding portfolio of services. As a result, customer requests can be processed and implemented more quickly and in a more targeted manner.

In order to define its portfolio as precisely as possible, the service provider can choose from a selection of around 70 machining options. In this way, the Supplier Network Tool forms a universal platform for the employees of thyssenkrupp Schulte, with which a cross-border search for the right suppliers can be carried out throughout Europe. Continuous enhancement and management of the tool ensure that the information is up-to-date. In line with individual customer requirements, the search is precisely defined in the Supplier Network Tool and, in turn, the most optimal service provider for material processing is found.

"The tool forms a bridge between our customers and suppliers. Our business partners benefit from the fact that we have direct access to a comprehensive network of services. This enables us to process customer inquiries quickly and accurately," says Sefa Dogansoy, Head of Supplier Network at thyssenkrupp Schulte.

thyssenkrupp Schulte

Tata Steel launches low-CO_2 steel

Tata Steel Nederland has launched its new Zeremis® Carbon Lite steel.

The lower CO_2 intensity of this steel has been certified by independent assurance expert DNV and is based on CO_2 savings realized within Tata Steel Nederland since 2018. Tata Steel feels the urgency to further minimize its environmental impact. The company has committed to switch to green hydrogen-based steelmaking, with CO_2 emission reduction of at least 30% to be achieved by 2030, when it commissions its first DRI installation. The ultimate goal is to produce all steel without any CO_2 emissions by 2050.

Tata Steel Nederland

New model launched

The FSE electric sideloader from Combilift

Irish forklift manufacturer Combilift has added yet another line to its now extensive electric range with the launch of the Combi-FSE – a four wheeled, two directional sideloader in both 5 t or or 6 t lift capacity

As part Combilift's drive to help customers achieve their aims of more sustainable operations, over 60% of the company's output is now electric. Recent models such as the Combi-XLE and now the Combi-FSE focus on heavier duty application for industry sectors such as timber, steel, tubes & pipes and builders merchants. Thanks to Combilift's immense engineering and design experience, the Combi-FSE delivers on all aspects of reliability, durability, powerful performance and ease of maintenance, combined of course with the quiet and emission free electric operation that more and more customers are demanding.

The patented traction system in this new product plays a major part in ensuring the optimum performance of the Combi-FSE in all weather conditions. Sensors in the front steering axle linked to the innovative Electronic Traction Control system enable the 2 independent 15kW drive motors on the rear axle to be controlled individually, with the speed of each wheel governed by the steer angle of the front wheels to provide improved steering control for the operator, better truck turning radius and reduced tyre wear. This new technology, when combined with regenerative braking (which recaptures the truck's kinetic energy during deceleration and can be used to recharge the batteries to extend battery life), makes for Combilift's most advanced steering system on its four wheeled trucks to date.

> "With our electric models we will help our customers to drastically reduce their carbon footprint."
>
> *Martin McVicar, Combilift CEO*

The generous glazing of the cab, particularly the roof to floor windscreen, allows the operator to have an excellent field of vison of the load, the machine and the surroundings. Considerable engineering development to ensure optimum visibility for the driver saw the perfection of the under-deck battery system, with the power pack strategically placed at the rear of the truck between the drive motors – giving a clear line of sight to the rear and when reversing, and guaranteeing the best operator visibility of any comparable truck. This position also enables safe and easy battery removal from the low-level rear of the truck.

Maintenance time has been kept to a minimum due to key service features such as its quick interchangeable battery for shift work, centralised grease points on the front and rear of the load platform and removable panels for easy access to the motor.

Combilift CEO Martin McVicar commented: "We introduced our first 4-wheel sideloader around 10 years ago after initial requests from companies in the timber sector, and it has since become pretty much a standard solution for those who run intensive schedules which clock up many operational hours. The technological advancements in battery technology since then means that it was a natural progression to develop this electric model, which will help customers to drastically reduce their carbon footprint."

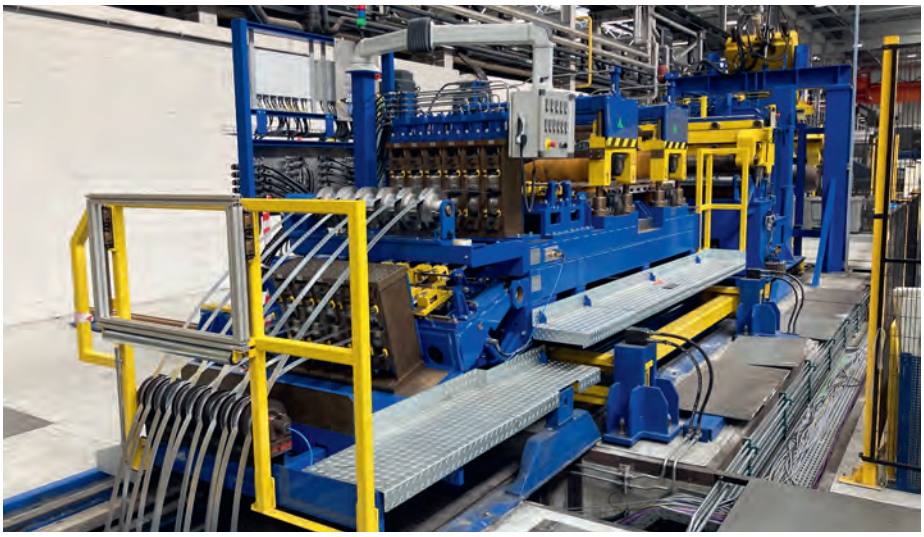
The electric four wheel sideloader forklift designed for the safe, space saving and productive handling of long and bulky loads (Picture: Combilift)

Combilift

Strips without burrs facilitate further processing

Slit strip with perfect rounded edges

Wuppermann Hungary has extended the recently modernised slitting line with an arrondising plant and added a traverse winder



Arrondising plant at Wuppermann Hungary (Picture: Wuppermann)

Wuppermann Hungary Kft. now also supplies rounded and/or traverse-wound slit strip. The new traverse-winding-system was successfully commissioned earlier this year. The system is a downstream unit of the slitting line, which was already modernised at the end of 2021. With the modernisation, a new, state-of-the-art arrondising plant also went into operation.

Slit strip with rounded edges offers advantages in further processing as well as in the subsequent use of the end product. Rounded strips without burrs can be clamped more easily in tools. Surface treatment is more efficient. Surface treatment can be carried out more efficiently on rounded edges and coatings, such as paint, hold much better. From a safety point of view, burrs represent a risk of injury when handling the material in further processing steps and can lead to cuts during further processing. Rounded slit strips do not have this risk of injury – on the contrary: they protect against it.

From a technical point of view, the rounding off is a mechanical rounding of the cut edges, in which the zinc or zinc-magnesium coating is also pushed over the cut edges. In this way, the corrosion protection can be extended beyond the edges and the so-called cathodic edge protection can be strengthened or, in the case of thicker slit strips, brought about. Traverse-wound material ensures more throughput in further processing and significantly reduces set-up times, as more material can be wound onto one coil. Each traverse-wound coil increases productivity and enables longer continuous production. By requiring fewer coils to be reloaded, machine downtime and coil handling is minimised, and the required storage space and scrap generated are significantly reduced.

The conversion and expansion measure will be completed with the integration and commissioning of a fully automatic packaging in February 2022. In the future, the rounded and traverse-wound products will be galvanised inline directly in Hungary and further processed to the respective product, so that the logistical effort from production to the end customer will be significantly improved. This will save delivery routes and reduce CO_2 emissions.

Wuppermann Group

Advanced material flow for small batch sizes

Fully automated from the raw material to the prefabricated pieces ready for dispatch

The Austrian steel distribution company EHG relies on the intelligent interlinking of internal logistics and prefabrication processes. All machines – from material supply to container and pallet handling – have been integrated into one smart system.

More than just a steel distributor and supplier, EHG provides solutions as a systems provider and an expert partner: This is the company image conveyed by EHG Stahlzentrum GmbH & CO OG located in Austria. Founded in 1963 in Dornbirn, located near the German and Swiss border, the company has developed into an internationally active, independent full-service supplier for industry, business, skilled crafts and trade. With a total stock of around 45,000 tonnes, the range of goods includes more than 15,000 items in over 140 grades and countless dimensions of steel and metal. "With that, we have one of the best-stocked warehouses in all of Central Europe," explains Christian Rüf, head of logistics systems and processes at EHG. "This ensures a high degree of availability and short delivery times."

However, the wide range of services is just as important to EHG as the large warehouse assortment. "We don't think in terms of products, but rather in terms of solutions" Rüf continues. "This means that we supply our customers with the items they need directly to the production which are already cut-to-size and just in time" This strategy also includes the broad delivery area: EHG provides not only to companies in Austria, Germany and Switzerland, but also Italy, Slovenia, Hungary, Slovakia, the Czech Republic and Romania. The company network now comprises ten sites with a total of about 360 employees and around 6,000 customers. However, 90 per cent of deliveries are shipped from the headquarters in Dornbirn – either by a freight forwarder or with the company's vehicle fleet.

Large number of orders, small quantities and time constraints

Efficient and trouble-free processing and logistics processes are significant factors in the success of EHG's business model.

Austrian steel distributor EHG utilises two fully automated sawing cells from KASTO at its headquarters in Dornbirn (Picture: KASTO)

"We process about 620,000 order items per year, primarily in small batches of less than ten items," says Rüf, describing the challenge. "During this process, we are under an enormous time crunch. In some cases, we only have one to two hours to complete an order." On this backdrop, EHG utilises highly advanced storage and processing technology: The Dornbirn site has, among other things, eight fully automatic high bay storage systems, 40 automatic band and circular sawing machines and two independent sawing centres. "This equipment makes us the most modern sawing and cutting centre in Europe", Rüf reports.

For many years, EHG has relied on the products and expertise of KASTO Maschinenbau GmbH & Co. KG. The company, located in Achern in southern Germany, offers automatic storage systems and sawing machines, robotic and handling solutions for metal bar stock, including the appurtenant software from a single source. "Our state-of-the-art high bay storage systems all stem from KASTO. For instance, we installed four UNICOMPACT honeycomb storage systems just for storing bars, tubes and profiles, as well as another one for storing sheet metal," Rüf describes. "Moreover, 27 KASTO automatic saws are in operation in Dornbirn, ranging from compact and flexible production circular saws to heavy-duty block and plate bandsaws. We have the ideal machine for any materials and dimensions."

Independent sawing centres save arduous work

The head of logistics is particularly proud of the two fully automatic sawing centres, in which all work steps are carried out completely operator free, from the feeding of the stored raw material to the sorting and stacking of the cut pieces. "Here, we process primarily frequently used materials in small batch sizes," Rüf explains. "The major advantage of this is the efficient and fast material changeover." The saws are directly connected to one of the high bay storage systems and are independently supplied with the required bar stock by its operating gantry crane (OGC), without the need of employee intervention. "That saves us the arduous work of manually feeding the steel into the machine, most of which is extremely heavy and up to six metres in length."

EHG commissioned the first of its two sawing centres in the year 2000 and the system was expanded in 2019. It is equipped with a high-performance circular saw from the KASTOvariospeed series. The machine is designed specifically for the fully automatic processing of quick-changing orders. "The decisive factor for this purchase was that after about 20 years of service, one of our saws had reached the end of its service life and required replacement. As a result, we decided to invest more in automation to make our processes more efficient and to relieve our employees." It was not surprising that KASTO was also selected for this project: After all, the company has not only been a preferred supplier for years, but as a manufacturer of both sawing and storage technology, it has the necessary expertise needed to implement integrated complete systems.

From the saw to the shipping box via robot

In turn, an industrial robot is connected to the saw, which automatically removes the finished cut pieces from the working area of the machine using various grippers, deburrs them and sorts them according to the order. The parts are placed in various sizes of cardboard and plastic boxes that are also supplied by machine. "KASTO has developed an outstanding solution for us", Rüf explains. "A container carousel with eight pallet spaces on which the robot can independently place and fill the respective boxes."

The cardboard and plastic boxes, each in six different sizes, enter the robot's work area via inclined roller conveyors. Based on the order data, the control system of the saw centre determines the suitable container for the respective workpieces, which the robot then places on the pallet provided with the help of a suction device. While the sections are being cut and stacked, a printer creates a shipping label for the current order in parallel. The robot also places the label in the corresponding box using the suction device. Once a pallet is filled, the carousel rotates one space further, making a new load carrier available. The employees use a pallet truck or forklift to transport the pallets with the prefabricated goods to the shipping department.

Pallet buffer enables autonomous operation

The system's control system is connected to the warehouse management system used at EHG via an interface created specifically for this purpose. "This allows us to generate and process orders fully automatically," says Rüf, explaining the advantages. "We benefit from a single controlled and managed material flow, with little human intervention required throughout the process from incoming to outgoing goods." Thanks to the buffer of up to eight pallets, we can also operate the sawing centre autonomously over a more extended period, for instance, overnight. "This ensures a high output and efficient processing of all incurring orders," describes the satisfied head of logistics.

KASTO's solution impressed those responsible at EHG to such an extent that in 2020, they expanded another sawing centre, which was purchased in 2007, with new sawing technology. "The primary reason for this was that we wanted to expand our existing high bay storage system and at the same time create an additional order picking hall," Rüf explains. "The new sawing cell is integrated into our facilities in such a way that it can independently access stock from two storage areas." It is equipped with the high-performance automatic circular sawing machine KASTOgripspeed C 10, designed for the equally fast and precise cutting of different types of steel. One particular advantage of the machine is its feed vice technology, which ensures a long service life with low wear. The second sawing centre is likewise equipped with a handling robot and a container carousel. "With this saw and the corresponding peripheral devices, we have once again significantly expanded our capacities and are now optimally equipped for the increasing number of orders with small batch sizes," explains Rüf.

A robot places the required boxes on a pallet provided with the help of a suction device and fills them with cut-pieces (Picture: KASTO)

Based on the order data, KASTOsort determines the suitable container for the respective workpieces (Picture: KASTO)

Result: faster, improved and more efficient work

EHG is fully satisfied with its new KASTO systems. "The integration of the individual machines into a continuous system is certainly unique in this form," finds Rüf. "Of course, it provides us with the advantage of having only one contact person to take care of all of our questions and concerns." In case of malfunctions, the experts from KASTO can connect to the system via remote maintenance and quickly provide assistance to avoid expensive downtimes. However, this is rarely needed: "The sawing cells are extremely reliable and easy to operate," Rüf notes. "They are a true asset to our company, enabling us to complete our work faster, better and more efficiently."

KASTO Maschinenbau

Mannesmann Grossrohr to supply pipes linking up to LNG terminal in Germany

Pipes for LNG transport produced by Mannesmann Grossrohr GmbH (Photo: Salzgitter AG)

Salzgitter AG subsidiary Mannesmann Grossrohr GmbH (MGR) has been commissioned by Gasunie Deutschland to produce and deliver the pipes for the energy transport pipeline 180 (ETL 180) to the LNG gas terminal in Brunsbüttel.

Featuring a diameter of DN 800, the pipeline will cover a distance of around 54 km. Some 3,200 pipes are to be delivered by February 2023 and have been specified for the handling of hydrogen in future. As Mannesmann Grossrohr is already producing the pipes for the connecting pipeline to the Wilhelmshaven LNG terminal, it has now also been assigned with supplying the pipes for the link to the Brunsbüttel LNG terminal. Commissioning of the line is scheduled to take place by the end of 2023.

Salzgitter AG

Shape and SSAB to partner on fossil-free steel for automotive applications

Shape Corp. is going to market fossil-free steel and body structure systems under a new agreement with SSAB.

Tier-one automotive supplier Shape will be testing SSAB's fossil-free steel, the first steel product made of hydrogen-reduced sponge iron utilizing HYBRIT technology, for use in automotive applications. "We are excited to welcome Shape as our first partner for fossil-free steel in the U.S. and look forward to jointly explore ways to mitigate climate change," says Martin Lindqvist, President and CEO at SSAB.

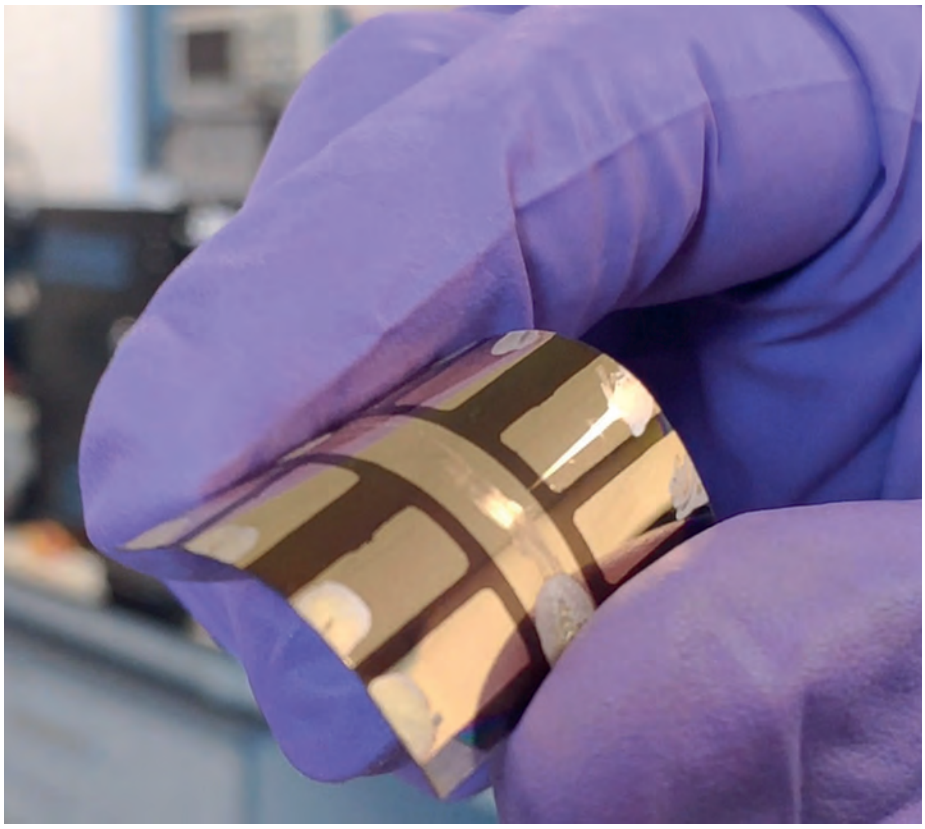
Shape Corp. will be offering products made with this innovative material in order to provide a green steel, lightweight alternative for OEM body structure components that aligns with Shape's own carbon neutrality goals.

SSAB aims to deliver fossil-free steel to the market in commercial scale during 2026. SSAB works with iron ore producer LKAB and energy company Vattenfall as part of the HYBRIT initiative to develop a value chain for fossil-free iron and steel production, replacing the coking coal traditionally used for iron ore-based steelmaking with fossil-free electricity and hydrogen. This process virtually eliminates carbon dioxide emissions in steel production.

Shape Corp.

Tata Steel cooperates with university on new solar cell technology

Solar roofing panels, which are greener, lighter, cheaper and flexible, and which can be printed on the steel used in buildings, are the focus of a new three-year research collaboration between experts from Swansea University and Tata Steel UK.



Flexible printable and silicon-free solar cell (Photo: Tata Steel)

The solar roofs would enable buildings to generate, store and release their own secure supply of electricity. This would reduce reliance on fossil fuel energy such as gas, and ease pressure on the electricity grid, especially as surplus power generated by a building can be used to charge up electric vehicles.

The concept is called Active Buildings and it has already been shown to work. Two Active Buildings have been in operation successfully on the Swansea University campus for several years. The aim of the new research is to explore the potential of this technology further and speed up the process of turning it into products for industry to manufacture.

Traditional solar cells are manufactured from silicon, which is expensive and requires a lot of energy to produce. But a new highly efficient type of cell, called a perovskite solar cell (PSC), is a cheaper and lighter alternative to silicon-based solar panels. PSCs can be made locally using widely available materials and manufacturing them emits less than half the carbon compared to a silicon cell.

Crucially, another advantage of PSCs over silicon is that they are flexible rather than rigid. This means they can be printed, using techniques such as screen printing, directly onto a material such as coated steel. This opens the door to creating innovative steel products for use in the construction industry that have built-in solar generating technology.

Swansea University will contribute expertise in manufacturing the printable cells, led by the SPECIFIC Innovation Centre, which pioneered the concept of Active Buildings and designed and built the Active Office and Classroom. Tata Steel brings in their expertise in coatings on steel, screen printing and supply chains for materials.

Tata Steel

Gebhardt-Stahl uses CO_2-reduced steel and product carbon footprint calculator

Expert for steel profiles, Gebhardt-Stahl, uses customized, CO_2e-reduced slit strip from thyssenkrupp Materials Processing Europe to promote sustainable housebuilding. thyssenkrupp Materials Processing Europe calculates the exact CO_2e footprint of the material from production to delivery for Gebhardt-Stahl customer.

The bluemint® recycled material from thyssenkrupp Steel Europe is of particular importance in this project: The product can demonstrate a reduction in CO_2e emissions of over 60% due to modified input materials. In addition, the steel is characterized by a high proportion of recycled material. The reduced value of the material's CO_2 emissions as a result of the more environmentally friendly production is incorporated in the model for calculating the Product Carbon Footprint (PCF) at thyssenkrupp Materials Processing Europe.

The PCF calculator calculates the exact CO_2e emissions for each product from production to delivery. For each article, it is thus possible to transparently show all steps from production to delivery, storage and processing to delivery to the customer in terms of greenhouse gas impact. This means that all data along the entire supply chain to the customer, the so-called "cradle to gate" approach, is taken into account. The sophisticated calculation logic of the PCF calculator has been certified by the international classification society DNV and is being used for the first time in the delivery to Gebhardt-Stahl.

thyssenkrupp Materials Services

Shop floor logistics

Automatic handling of tube bundles at the scaffolding manufacturer Layer

System solution comprises five automatic cranes in goods-in storage area and processing zones, including conveyor technology, goods management and safety equipment

Demag Cranes & Components will provide automation of the incoming goods area and the operation to serve production areas used to process raw materials at the new plant operated by Wilhelm Layher GmbH & Co KG. The world leader in the manufacture of scaffolding systems is planning to build a new production line in Güglingen-Cleebronn in the south-west of Germany and awarded a contract to Demag to design and implement the corresponding automated crane and materials handling system, as well as the required safety equipment.

The installation of five automated process cranes will ensure that the tubes will be effectively stored, picked, and supplied on time with a material flow used to manufacture components for scaffolding, all with a very high degree of automation. The planned throughput for the new plant is 120,000 tonnes per year and 25 tonnes per hour.

New building with automated material flow

Layher is planning to build an independent plant in Güglingen-Cleebronn for the production and hot-dip galvanizing of parts for its all-round scaffolding system. "Plant 3" will cover an area of approximately eleven hectares, of which around five will consist of roofed production and storage areas. The production process for the entire location is scheduled to kick off there starting in 2023: This means galvanizing the scaffolding elements and, depending on the specific component, the corresponding hot working, ledger welding, standard element welding, and assembly as well.

Bundles of tubes will be delivered from various production plants and then placed in Demag stacking racks at transfer stations to the inbound goods storage area. After the material data is captured by the Demag

The tubes will be effectively stored, picked and supplied on time for the production of components for scaffolding, with a very high degree of automation
(Picture: Demag Cranes & Components)

Warehouse management system (WMS) and registered with the customer's SAP Hana system, two Demag crane systems take care of the automated material transport operation. To do this, the cranes, which have an 8 t load capacity and 25 m span, store the stacking racks until they are called up for production. The WMS will use various parameters to determine the storage locations for the bundles of tubes, which will vary in terms of length and wall thickness. The crane systems will also take care of automated stock retrieval. To this end, the bundles of tubes will be placed on one of three conveyor lines that will then transfer the bundles to the intended production area.

In future, three additional automatic cranes with span dimensions of 11 m and a load capacity of 8 tonnes will operate in the ledger-welding/cutting areas and in the hot working area. These process cranes will transport the individual bundles to the intermediate storage areas upstream of production – alternatively, they will also take care of serving individual machines with stock directly.

> "The complexity is the result not just of the turnkey delivery and planning scope, but also of the fact that a lot of unique requirements had to be considered during planning."
>
> *Dr Thomas Bönker, Senior Vice President Process Cranes at Demag Cranes & Components*

Efficient control with warehouse management system

In addition to the delivery data from inbound trucks, the Demag WMS system will incorporate and process production plans and data from the Layher quality assurance system. In the production area, bundles of tubes will be temporarily stored on a platform above the processing machines with a planned buffer of one production day to ensure that material is supplied quickly, while maintaining a high degree of flexibility. This intermediate storage area, as well as the transfer of material between the areas, will also be managed by the Demag WMS system.

Goods movements will be carried out in sequence, starting from delivery to one of the two inbound goods storage areas, then from those storage areas to the intermediate storage area for production, and finally from this latter area to the processing machines. The sequence in which material will be transferred will be computed and automatically carried out by the Demag WMS system according to needs determined with the customer's advanced production planning system. The cranes and the materials handling equipment will automatically retrieve the requested bundles of tubes and transfer them based on retrieval jobs from the Demag WMS system. To achieve this, the automatic crane in the inbound goods storage area selected by the WMS system will place the corresponding rack on transfer stations provided by Demag for the conveyor lines to production. The Demag WMS system will organize retrieval operations on the FIFO principle, and will also be able to re-organise stock to create stacks of bundles of the same type when workloads are low, for example. In fact, it will even be able to transfer material between the two bays.

Demag supplies complete system solution

The fact that Demag is delivering the two automatic cranes for this project is not unusual. After all, the company is one of the world's leading manufacturers of automated cranes and has extensive experience in handling long stock. This also includes implementation of the Demag Warehouse Management System (WMS). This software for internal material flows is tried and tested globally in various applications for process cranes, including steel and paper roll storage operations as well as for press tools in the automotive industry.

What is less ordinary, however, is the fact that Demag is not just designing and installing cranes for this project, but a complete system solution for the ground-level and overhead material flows, including the corresponding long material store. Accordingly, Layher is applying its own strategy as a leading manufacturer of scaffolding systems to material flow planning as well.

Thomas Bönker, Senior Vice President Process Cranes: "We're glad that we were able to win this very challenging contract. The complexity is the result not just of the turnkey delivery and planning scope, but also of the fact that a lot of unique requirements had to be considered during planning together with our customer Layher. Thanks to this partnership, which was already initiated at an early stage, we were able to identify and exploit significant potential for improvements in advance."

The scope of supply also includes comprehensive safety equipment for access control to the handover areas between cranes and processing machines. The process at the bundle loading magazines in the production area, in particular, required especially careful planning. To ensure a safe work environment, Demag will be using extensive safety equipment and automatically moving safety guards and equipment between machines and the storage area.

Demag Cranes & Components

STEEL SUPPLIERS INTERNATIONAL

SUPPLIER FOR THE INTERNATIONAL STEEL INDUSTRY FROM A TO Z

01	Raw materials, auxiliary materials and operating materials	16	Furnace and energy technology
02	Raw material pretreatment	17	Refractory technology
03	Iron making	18	Machinery and plant engineering
04	Steelmaking	19	Transport and storage technique
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06	Near net shape casting	21	Measuring and testing technique
07	Hot rolling	22	Materials testing
08	Forging, extrusion	23	Analysis and laboratory equipment
09	Powder metallurgy	24	Environmental protection and disposal
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11	Surface treatment	26	Other products
12	Production of bright steel and wire	27	Consulting, planning and services
13	Production of tubes/pipes	28	Steel in civil engineering
14	Sheet metal processing	30	Service concerning steel materials
15	Steel products		

01 Raw materials, auxiliary materials and operating materials

01.05 Metals and alloys

380 Alloys

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02 Raw material pretreatment

02.04 Pelletising plants

797 Conveying plants for pellets

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02.05 Sintering plants

822 Sinter hot material conveyors

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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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1172 DRI hot material conveyor

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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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1699 Steel mill equipment

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04.04 Electric steel plant

1875 Electric arc ladle furnaces

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E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

04.07 Secondary metallurgy

2028 Equipment for chemical heating

LOI Thermprocess GmbH
Schifferstraße 80
47059 Duisburg, Germany
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🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

2030 Argon purging equipment

LOI Thermprocess GmbH
Schifferstraße 80
47059 Duisburg, Germany
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🖷 +49 203 80398-901
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Internet: www.loi.tenova.com

2080 Ladle metallurgical plants

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47059 Duisburg, Germany
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🖷 +49 203 80398-901
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Internet: www.loi.tenova.com

2110 Secondary metallurgical plants

LOI Thermprocess GmbH
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47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

2120 Steel degassing plants

LOI Thermprocess GmbH
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47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

2130 Steel desulfurization plants

LOI Thermprocess GmbH
Schifferstraße 80
47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

2140 T+P lance equipment

LOI Thermprocess GmbH
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47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

04.08 Tertiary metallurgy

2144 Vacuum degassing equipment

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47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

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

2230 Charging machines (trough and tongs)

DANGO & DIENENTHAL
BETTER VALUES.

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

04.09 Components

2580 Oxygen nozzles

tenova
LOI THERMPROCESS

LOI Thermprocess GmbH
Schifferstraße 80
47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

04.10 Steel works materials

2735 EBT taphole plugging compound

WEEBOTEC

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

2880 Ladle slide sand

WEEBOTEC

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

07 Hot rolling

07.05 Bar and wire rod mills

3940 Reducing and calibrating mills

KOCKS
Know-how for tomorrow

Friedrich KOCKS GmbH & Co. KG
Neustraße 3
40721 Hilden, Germany
E-Mail: sales@kocks.de
Internet: www.kocks.de

3944 Reducing and sizing mills

KOCKS
Know-how for tomorrow

Friedrich KOCKS GmbH & Co. KG
Neustraße 3
40721 Hilden, Germany
E-Mail: sales@kocks.de
Internet: www.kocks.de

3950 Bar and wire rod mills

KOCKS
Know-how for tomorrow

Friedrich KOCKS GmbH & Co. KG
Neustraße 3
40721 Hilden, Germany
E-Mail: sales@kocks.de
Internet: www.kocks.de

3960 Bar mills

KOCKS
Know-how for tomorrow

Friedrich KOCKS GmbH & Co. KG
Neustraße 3
40721 Hilden, Germany
E-Mail: sales@kocks.de
Internet: www.kocks.de

3970 Rolling mills for long products

KOCKS
Know-how for tomorrow

Friedrich KOCKS GmbH & Co. KG
Neustraße 3
40721 Hilden, Germany
E-Mail: sales@kocks.de
Internet: www.kocks.de

07.10 Components

4430 Decoilers and rewinders

GUILD
INTERNATIONAL
World Leader in Coil Processing Equipment

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

DANGO & DIENENTHAL
BETTER VALUES.

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

GLAMA
Maschinenbau GmbH

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

5155 Forging manipulators, rail-mounted

DANGO & DIENENTHAL
BETTER VALUES.

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

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

5160 Forging robots

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

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

5180 Transport manipulators

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

LOI Thermprocess GmbH
Schifferstraße 80
47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

11 Surface treatment

11.04 Surface treatment plants

6270 Strip edge trimming

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

6280 Strip processing and finishing lines

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

6390 Shot peening

AGTOS Gesellschaft für technische Oberflächensysteme mbH
Gutenbergstr. 14
48282 Emsdetten, Germany
☎ +49 2572 96026-0
🖷 +49 2572 96026-111
E-Mail: info@agtos.de
Internet: www.agtos.de

6565 Blasting plants

AGTOS Gesellschaft für technische Oberflächensysteme mbH
Gutenbergstr. 14
48282 Emsdetten, Germany
☎ +49 2572 96026-0
🖷 +49 2572 96026-111
E-Mail: info@agtos.de
Internet: www.agtos.de

11.05 Aluminizing, tin plating, galvanizing

6630 Hot dip galvanizing lines

LOI Thermprocess GmbH
Schifferstraße 80
47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

13 Production of tubes / pipes

13.01 Tube rolling mills

7360 Pipe rolling mills with planetary cross rolling mill

Friedrich KOCKS GmbH & Co. KG
Neustraße 3
40721 Hilden, Germany
E-Mail: sales@kocks.de
Internet: www.kocks.de

7390 Stretch-reducing mills

Friedrich KOCKS GmbH & Co. KG
Neustraße 3
40721 Hilden, Germany
E-Mail: sales@kocks.de
Internet: www.kocks.de

13.04 Finishing lines for tubes

7520 Tube bending 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

7544 Tube straightening 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

14 Sheet metal processing

14.03 Welding technology

8120 Strip welding machines

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

8205 Laser welding machines

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

8210 Laser beam welding machines

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

8220 MIG, MAG and TIG \ 057TIG welding torches

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

8257 Rolling seam resistance welding equipment

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

8330 Welding machines, general

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

8360 Welding accessories, general

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

8380 Butt welding machines, electric

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

8400 Resistance welding equipment

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

16 Furnace and energy technology

10170 Furnace optimization (conversion to low NOx combustion)

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☎ +49 203 80398-900
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WS Wärmeprozesstechnik GmbH
Dornierstr. 14
71272 Renningen, Germany
☎ +49 7159 1632-0
🖷 +49 7159 2738
E-Mail: ws@flox.com
Internet: www.flox.com

10190 Rational use of energy

WS Wärmeprozesstechnik GmbH
Dornierstr. 14
71272 Renningen, Germany
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🖷 +49 7159 2738
E-Mail: ws@flox.com
Internet: www.flox.com

16.02 Forging furnaces

10230 Forging furnaces

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47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

16.03 Roller Hearth Continuous Furnaces

10260 Roller Hearth Continuous Furnaces

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47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

10270 Roller hearth and walking beam furnaces

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47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

16.05 Top-hat furnaces

10310 Top-hat furnaces

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☎ +49 203 80398-900
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Internet: www.loi.tenova.com

16.07 Hardening and tempering equipment

10355 Carburizing furnaces

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🖷 +49 203 80398-901
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Internet: www.loi.tenova.com

16.08 Heating furnaces and heat treatment plants

10408 Continuous furnaces

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☎ +49 203 80398-900
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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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Internet: www.loi.tenova.com

10510 Roller hearth and walking beam furnaces

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10540 Pusher-type, roller and rotary hearth furnaces

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🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

10560 Heat treatment plants

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☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

10562 Heat treatment furnaces (continuous and discontinuous)

LOI Thermprocess GmbH
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47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

10570 Heat treatment furnaces for batch operation, open heated

LOI Thermprocess GmbH
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47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

16.09 Bath furnaces

10580 Aluminum melting furnaces

LOI Thermprocess GmbH
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47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

16.13 Components

10890 Natural gas burners

WS Wärmeprozesstechnik GmbH
Dornierstr. 14
71272 Renningen, Germany
☎ +49 7159 1632-0
🖷 +49 7159 2738
E-Mail: ws@flox.com
Internet: www.flox.com

11010 Regenerative burners

WS Wärmeprozesstechnik GmbH
Dornierstr. 14
71272 Renningen, Germany
☎ +49 7159 1632-0
🖷 +49 7159 2738
E-Mail: ws@flox.com
Internet: www.flox.com

11020 Recuperative burners

WS Wärmeprozesstechnik GmbH
Dornierstr. 14
71272 Renningen, Germany
☎ +49 7159 1632-0
🖷 +49 7159 2738
E-Mail: ws@flox.com
Internet: www.flox.com

11070 Radiant tube burners

WS Wärmeprozesstechnik GmbH
Dornierstr. 14
71272 Renningen, Germany
☎ +49 7159 1632-0
🖷 +49 7159 2738
E-Mail: ws@flox.com
Internet: www.flox.com

18 Machinery and plant engineering

12210 Plant engineering, general

LOI Thermprocess GmbH
Schifferstraße 80
47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

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.

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

18.10 Power and work machines

13160 Vacuum pumps

LOI Thermprocess GmbH
Schifferstraße 80
47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

19 Transport and storage technique

14535 Hot material conveyors

AUMUND Fördertechnik GmbH
Saalhoffer Str. 17
47495 Rheinberg, Germany
☎ +49 2843 720
E-Mail: metallurgy@aumund.de
Internet: www.aumund.com

19.05 Continuous conveyors

14830 Conveyors (general)

AUMUND Fördertechnik GmbH
Saalhoffer Str. 17
47495 Rheinberg, Germany
☎ +49 2843 720
E-Mail: metallurgy@aumund.de
Internet: www.aumund.com

19.06 Cranes

14950 Cranes, hoists and accessories, general

WOKO Magnet- und Anlagenbau GmbH
Theodor-Heuss-Str. 57
47167 Duisburg, Germany
☎ +49 203 48275-0
🖷 +49 203 48275-25
E-Mail: woko@woko.de
Internet: www.woko.de

19.10 Components

15320 Electrical equipment for cranes etc.

WOKO Magnet- und Anlagenbau GmbH
Theodor-Heuss-Str. 57
47167 Duisburg, Germany
☎ +49 203 48275-0
🖷 +49 203 48275-25
E-Mail: woko@woko.de
Internet: www.woko.de

15490 Lifting magnets and equipment

WOKO Magnet- und Anlagenbau GmbH
Theodor-Heuss-Str. 57
47167 Duisburg, Germany
☎ +49 203 48275-0
🖷 +49 203 48275-25
E-Mail: woko@woko.de
Internet: www.woko.de

20 Electrical engineering and automation

20.02 Control and automation systems

16040 Automation systems for hot rolling mills and tube mills

Friedrich KOCKS GmbH & Co. KG
Neustraße 3
40721 Hilden, Germany
E-Mail: sales@kocks.de
Internet: www.kocks.de

16041 Automation systems for hot rolling mills

Friedrich KOCKS GmbH & Co. KG
Neustraße 3
40721 Hilden, Germany
E-Mail: sales@kocks.de
Internet: www.kocks.de

21 Measuring and testing technique

21.02 Measurement of physical properties

16850 Infrared switch

KELLER HCW GMBH
Carl-Keller-Str. 2 - 10
49479 Ibbenbüren, Germany
☎ +49 5451 85-0
🖷 +49 5451 85-310
Internet: www.keller.de

16860 Infrared radiation pyrometer

KELLER HCW GMBH
Carl-Keller-Str. 2 - 10
49479 Ibbenbüren, Germany
☎ +49 5451 85-0
🖷 +49 5451 85-310
Internet: www.keller.de

16871 Infrared Radiation Thermometer

KELLER HCW GMBH
Carl-Keller-Str. 2 - 10
49479 Ibbenbüren, Germany
☎ +49 5451 85-0
🖷 +49 5451 85-310
Internet: www.keller.de

16879 Cast iron temperature measurement

KELLER HCW GMBH
Carl-Keller-Str. 2 - 10
49479 Ibbenbüren, Germany
☎ +49 5451 85-0
🖷 +49 5451 85-310
Internet: www.keller.de

17060 Profile measuring systems (non-contact)

Friedrich KOCKS GmbH & Co. KG
Neustraße 3
40721 Hilden, Germany
E-Mail: sales@kocks.de
Internet: www.kocks.de

17080 Pyrometer

KELLER HCW GMBH
Carl-Keller-Str. 2 - 10
49479 Ibbenbüren, Germany
☎ +49 5451 85-0
🖷 +49 5451 85-310
Internet: www.keller.de

17100 Ratio pyrometer

KELLER HCW GMBH
Carl-Keller-Str. 2 - 10
49479 Ibbenbüren, Germany
☎ +49 5451 85-0
🖷 +49 5451 85-310
Internet: www.keller.de

17300 Rolling mill measuring systems

Friedrich KOCKS GmbH & Co. KG
Neustraße 3
40721 Hilden, Germany
E-Mail: sales@kocks.de
Internet: www.kocks.de

17325 2-color pyrometer with fiber optics

KELLER HCW GMBH
Carl-Keller-Str. 2 - 10
49479 Ibbenbüren, Germany
☎ +49 5451 85-0
🖷 +49 5451 85-310
Internet: www.keller.de

21.03 Quality management

17410 Surface inspection

Friedrich KOCKS GmbH & Co. KG
Neustraße 3
40721 Hilden, Germany
E-Mail: sales@kocks.de
Internet: www.kocks.de

24 Environmental protection and disposal

24.01 Dedusting and gas cleaning

18360 Exhaust gas cooling systems

LOI Thermprocess GmbH
Schifferstraße 80
47059 Duisburg, Germany
☎ +49 203 80398-900
🖷 +49 203 80398-901
E-Mail: loi@tenova.com
Internet: www.loi.tenova.com

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 Ferrobor
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, licker-ins
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 Oriel 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)
3490 bloom and billet adjustments
3500 Heat exchangers
3503 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

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
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

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
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

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 Slinging 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

ORDER FORM

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04 Steelmaking

04.10 Steel works materials

2735 EBT taphole plugging compound

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The next issue of STAHL + TECHNIK in German will be out in December and includes the following topics:

Steel technology

New twin ladle furnace to feed the CASTRIP plant in Mexico

A few years ago, the Mexican steel producer Talleres y Aceros S.A. de C.V. (TYASA) commissioned a CASTRIP plant for the production of hot strip coils at its Ixtaczoquitlán works. This resulted in a need for additional capacity for secondary metallurgy. The construction of a new twin ladle furnace will now eliminate this bottleneck. The steel plant's production will be increased. CASTRIP is a new kind of continuous casting technology in which thin hot strip is produced directly at the strip casting machine using casting rolls.

Optical flatness measurement on high-gloss metal surfaces

A large number of high-tech cameras connected in series, so-called camera cluster systems, enable exact flatness measurement even on high-gloss material. Thanks to high sampling rates and hardware-based FPGA image processing, the measurements are insensitive to vertical displacement and vibration. This guarantees the highest measurement accuracies for maximum quality demands.

Steel distribution and processing

Klöckner launches new umbrella brand for sustainable steel

Klöckner & Co is now marketing sustainable metal and service solutions under the new Nexigen® brand. In addition to CO_2-reduced steel and metal products, the offering also includes logistics and circularity solutions as well as consulting services. With the launch of the new brand, the first approximately 20 tonnes of significantly CO_2-reduced green steel (category "Pro") were delivered to the car manufacturer Mercedes-Benz.

Aviation on the upswing

High-performance materials and sophisticated special forgings have become indispensable in the aircrafts of the world's largest manufacturers. Only recently, the High Performance Metals Division of the voestalpine group secured not only a contract extension with the American aircraft manufacturer Boeing, but also several comprehensive new orders for the supply of heavy-duty components. In addition, the renowned Munich-based company MTU Aero Engines commissioned voestalpine to supply highly demanding forged parts that will be installed in various types of Airbus aircraft, such as the A320neo, in the coming years.

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