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INTERVIEW

ecoMetals campaign during METEC 2023 international trade fair for metallurgy

DECARBONISATION

CO₂ reduction and carbon capture and usage trials at ironmaking sites

STEELMAKING

Digimelter® technology combines power, intelligence, and eco-friendly equipment

STEEL DISTRIBUTION

The new “myE-service” tool from heavy-plate manufacturer Dillinger



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PAUL WURTH

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The fossil free pathway

In order to reduce the CO₂ emissions produced in metallurgical plants, the most obvious thing to do would seem to be to capture the CO₂. But what can be done with it? Subsurface storage is politically hardly thinkable, at least in the densely populated industrial regions of Western and Central Europe. Therefore, some steel companies have been working on concepts for carbon capture and utilisation for several years.

At ArcelorMittal, there is one concept for carbon capture and usage called "Steelanol", whereby the CO₂ produced is converted into ethanol. The first industrial Steelanol plant recently went into operation at the steel site in Ghent, Belgium. ArcelorMittal has meanwhile brought other partner companies on board to collaborate on multi-year trials of carbon capture technology. Together they will conduct a feasibility and design study to support the progress to full scale deployment. You can read more details about this programme starting on page 24 in this issue and also about the first major transformation project of an integrated iron and steel works in North America.

In the value chain, reduction, or to be precise iron making, is followed by crude steel production. Today, these two process stages are mostly integrated and are collectively referred to as the liquid phase. In the future, the liquid phase will probably only take place in the steel plant in many cases, as is the case today in the electric steel making plants. Hence, a boom in EAF plant technology is to be expected. As one of the leading manufacturers of electric arc furnaces, Danieli presents the Digimelter in this issue, starting on page 30, which is considered the last innovation stage of this technology. However, as here, too, some decarbonisation challenges

await, this is followed by an article on a substitute for anthracite, the main source of charge carbon in electric steelmaking.

In our Steel Distribution section (from page 54), this issue is primarily about digitalisation. In line with the motto "All business is local", every location faces some of the same challenges, regardless of whether it belongs to a large group or not.

That steel products will undoubtedly be needed in the future is demonstrated by some interesting examples in our Steel Processing section (from page 61). Even if it sounds like a cliché: it is about renewable energies, electric vehicles, OCTG and also quite avant-garde mobility.

It could be a beautiful vision of a bright future. But steel is also needed for the means to humanitarian aid and to overcome so many horrors nowadays, such as the devastation caused by the massive earthquakes in Turkey and Syria and by Russia's cruel war of aggression in Ukraine. Keep in mind and keep our mills running.



Arnt Hannewald,
Dipl.-Ing., Editor

Arnt Hannewald



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■ STEEL DISTRIBUTION

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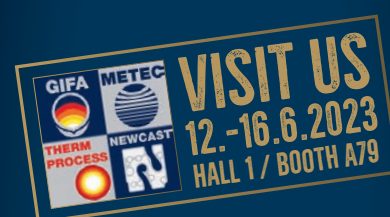
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Access to all data on order and production with the new "myE-service" tool from plate manufacturer Dillinger



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German service center specialist has optimized the exchange of data with its customers via edi and added several new functions

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The steel sector is crucial to decarbonising the energy supply and the UK will need more than 10 million tonnes of steel in the coming years

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64 Zeleros and ArcelorMittal test the performance of steel for hyperloops

A unique ultra-high-speed testing facility has been designed to evaluate the materials



Schaeffler appoints new President Industrial Europe

Christian Zeidlhack has been appointed as the new President of Schaeffler's Industrial Business in Europe and CEO of its Central and Eastern Europe subregion. He replaces Marcus Eisenhuth, who is leaving the company effective March 31, 2023. In his new role, Christian Zeidlhack is in charge of the Industrial division's direct-customer and sales-partner business for the whole of Europe as well as all

the company's operations in Central and Eastern Europe. On completing his studies in business management and industrial engineering, Christian Zeidlhack started his working life at the Daimler Group. He has been with Schaeffler, working in the company's Industrial division, since 2007.

■ *Schaeffler*

Christian Zeidlhack, Schaeffler's new President Industrial Europe and CEO of the Central and Eastern Europe subregion (Picture: Schaeffler)

Change of leadership at Siemens Large Drives Applications

Michael Reichle is the new CEO of Siemens Large Drives Applications (LDA) and will become CEO of the newly formed integrated motors and large drives company later this year. Michael Reichle has been appointed CEO of Siemens Portfolio Company Large Drives Applications (LDA). He succeeds Hermann Kleinod, who will remain an integral part of the global LDA management team. As CEO, Reichle

assumes all areas of responsibility of his predecessor.

Reichle will also take over as CEO of the new integrated motors and large drives company to be founded. At its annual press conference on November 17, 2022, Siemens announced that it would combine its Large Drives Applications, Low Voltage Motors, Geared Motors, Weiss Spindeltechnologie and Sykatec business units

under a single roof. The planned new company is to operate under its own legal form and outside the core business of Siemens AG; its headquarters are to be in Germany. Christoph Salentin will remain CFO of LDA and will then also assume responsibility as CFO for the new company.

■ *Siemens*

United States Steel Corporation appoints new executives

United States Steel Corporation has appointed two new executive leaders, Christian Gianni as Senior Vice President & Chief Technology Officer (CTO) and John Gordon as Senior Vice President, Raw Materials & Sustainable Resources.

Christian Gianni will lead efforts to drive innovation and product development, as well as enhance the company's manufacturing capability. He comes to U. S. Steel from Deka Research & Development Corporation, where he served as the execu-

tive leader for product development and manufacturing.

John Gordon will oversee the company's raw material supply chains to leverage iron ore assets as a unique competitive advantage capable of generating real value. This includes increasing the ability to become vertically integrated with U. S. Steel's mini mill segment. Before joining U. S. Steel, John Gordon spent four years at Johnson Matthey, a global leader in sustainable technologies, culminating in his position as Managing Director of the Platinum Group Metals Services division as well as President, Johnson Matthey (USA).

■ *U. S. Steel*

Christian Gianni (left) and John Gordon (right) have been appointed Senior Vice Presidents (Picture: U. S. Steel)



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Heike Denecke-Arnold to chair ESTAD 2023 conference

The Steel Institute VDEh has announced that Dr. Heike Denecke-Arnold, Chief Operations Officer and member of the Executive Board of thyssenkrupp Steel Europe, has taken over the patronage as the chair of the 6th European Steel Technology and Application Days (ESTAD).

“The European steel industry is currently facing huge challenges. It is on the way to becoming a vanguard to achieve climate neutrality in its production routes. The silver bullet to climate neutrality for steel production based on iron ores appears to be via hydrogen-based direct

reduction avoiding coal and coke for iron ore reduction,” says Dr. Denecke-Arnold, adding: “The METEC trade fair and the 6th ESTAD conference will provide answers to many of the pressing technical questions at hand and will therefore contribute to the further success of steel in Europe and around the globe.” The 6th European Steel Technology and Application Days will take place from 12 – 16 June 2023 concurrently with the METEC.

■ *Steel Institute VDEh*



Dr. Heike Denecke-Arnold will chair the upcoming METEC & 6th ESTAD 2023

(Picture: thyssenkrupp Steel Europe)



New General Manager After Sales at Aumund Fördertechnik

Marinus Kuijs is the new General Manager After Sales at Aumund Fördertechnik. Joining Aumund after more than 30 years with the thyssenkrupp group, he brings vast knowledge and cross-cultural expertise gained while holding various positions in Germany, the Netherlands, Turkey and

the Middle East. Before embarking on his career, Mari Kuijs, born in the Netherlands, qualified in energy technology, business administration and management studies.

■ *Aumund*

Mari Kuijs is the new General Manager After Sales at Aumund Fördertechnik

(Picture: Aumund)

Promotion to Executive Vice President at Nucor

Noah Hanners has been promoted to Executive Vice President of Nucor Corporation from his position as Vice President and General Manager of The David J. Joseph Company. Noah Hanners began

his career with Nucor in 2011 as melt shop engineer at Nucor Steel South Carolina. He later served as General Manager of Nucor Tubular Products and General Manager of Nucor Steel

Kankakee, Inc. and was promoted to Vice President in 2019.

■ *Nucor*

President of Alleima's tube division to leave the company

Michael Andersson, who has been President of the tube division of Alleima for around ten years, has announced to leave the group. Michael Andersson has been working for Alleima AB, formerly Sandvik Materials Technology, since 2002 altogether. A valued member of the Alleima management team, Michael Andersson will leave the company for personal reasons by mid-2023.

Nigel Haworth, currently President of Business Unit Energy at Alleima, has been appointed Acting President of the Tube division. The recruitment of a permanent successor for Michael Andersson has started.

■ *Alleima*



Michael Andersson has been President of the Alleima tube division for around ten years.

(Picture: Alleima)

EUROPE – AUSTRIA

Voestalpine to convert and modernize hot-dip galvanizing lines

Voestalpine has placed an order with Primetals Technologies for the modernization of its hot-dip galvanizing lines No. 3 and 4 in Linz.

Thanks to this investment, the plant will be able to produce steel grades with higher strengths, improved elongation values and a wider range of dimensions for the automotive industry.

As the availability of spare parts for hot-dip galvanizing line No. 3 is running out due to aging drive controls and automation technology, Primetals Technologies will upgrade more than 300 drive feeds, equip the automation units with new CPUs and install a new fieldbus system. Additionally, the plant's safety system will be brought up to the latest standards. The software library "PTLib", developed by Primetals Technologies, will be used for both lines. PTLib contains numerous function blocks for treatment plants and is continuously maintained, upgraded and updated to match the PCS7 versions.

By rebuilding and expanding hot-dip galvanizing line No. 4, voestalpine will be able to support the automotive industry in manufacturing even safer cars. The CO₂ footprint of automobiles can, at the same time, be reduced by producing lighter car



One of the two hot-dip galvanizing lines at voestalpine Linz undergoing major upgrading (Photo: voestalpine)

bodies while maintaining the same formability. Primetals Technologies will adapt and expand the existing electrical, drive and automation systems to meet the new requirements. As part of the contract, Primetals Technologies will also assemble provided components such as power

transformers and inductors. The entire modernization and conversion activities on both galvanizing lines will be carried out during planned shutdown periods.

■ *Primetals Technologies*

EUROPE – GERMANY

Rio Tinto proves suitability of low-carbon ironmaking process

Rio Tinto has proved the effectiveness of its low-carbon ironmaking process using ores from its mines in Australia in a small-scale pilot plant in Germany.

The process, known as Biolron™, uses raw biomass, instead of metallurgical coal as a reductant, and microwave energy to convert Pilbara iron ore to metallic iron in the steelmaking process. Biolron™ has the potential to support near-zero CO₂ steelmaking, and can result in net negative emissions if linked with carbon capture and storage.

Over the past 18 months, the process has been tested extensively in Germany

by a project team from Rio Tinto, sustainable technology company Metso Outotec, and the University of Nottingham's Microwave Process Engineering Group. Development work was conducted in a small-scale pilot plant using batches of 1,000 golf ball-sized iron ore and biomass briquettes. The Biolron™ process will now be tested on a larger scale, at a specially designed continuous pilot plant with a capacity of one tonne per hour. The design of the pilot plant is underway and Rio Tinto is considering suitable locations for its construction.

The process works using lignocellulosic biomass including agricultural by-prod-

ucts (e.g. wheat straw, canola stalks, barley straw, sugar cane bagasse) or purpose-grown crops. The biomass is blended with iron ore and heated by a combination of combusting gases released by the biomass and high-efficiency microwaves that can be powered by renewable energy.

Rio Tinto is aware of the complexities around the use of biomass supply and is working to ensure only sustainable sources of biomass are used. Accordingly, the company is undertaking a benchmarking study of biomass certification processes.

■ *Rio Tinto*

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With the order placed by CMC Steel for its fourth new, MIDA QLP hybrid-ready minimill, the Danieli scorecard hits 25 plants for long-product endless casting-rolling, out of 110 total minimills.



EUROPE – FINLAND

Blastr Green Steel plans investment in green steel plant

The Norwegian company Blastr Green Steel is planning to establish a green steel plant with an integrated hydrogen production facility in Inkoo, Finland.

Blastr has entered into a Letter of Intent with Nordic energy company Fortum that provides Blastr exclusive rights to utilize an existing industrial site located in Inkoo. Production is planned to start by the end of 2026.

“Finland is an ideal location for our project. It has an ambitious low-carbon target,

supportive and predictable operating conditions for the green industry, fossil-free energy, and a highly qualified workforce. Inkoo was selected as our location due to its high-quality infrastructure and access to clean power. In addition, the ice-free deep-sea harbour enables efficient, low-carbon logistics all year round and close access to the European market,” says Hans Fredrik Wittusen, CEO of Blastr Green Steel. Blastr will replace coke and coal with hydrogen in the chemical reduction phase, as well as reduce the CO₂ foot-

print along the entire value chain, with the aim of achieving 95% lower CO₂ emissions, compared to the conventional manufacturing process. The steel plant is planned to produce 2.5 million t/year of high-quality hot and cold-rolled green steel.

■ *Blastr Green Steel*

Outokumpu divests majority of its long products business

Outokumpu has completed the divestment of the majority of its long product business to Marcegaglia.

The transaction was carried out as a share sale. It comprised the sale of its melting, rod and bar operations in Sheffield, UK,

bar operations in Richburg, US, and the wire rod mill in Fagersta, Sweden. Outokumpu Long Products AB operating in Degerfors and Storfors in Sweden continues as a part of Outokumpu. “As for Outokumpu, we can now fully focus on our core business of stainless steel flat prod-

ucts and ferrochrome according to our strategy,” says Outokumpu’s President and CEO Heikki Malinen.

■ *Outokumpu*

Outokumpu restarts ferrochrome furnace earlier than planned

Outokumpu has restarted, earlier than planned, the ferrochrome furnace that was temporarily shut down in early September 2023, due to the high electricity prices.

The restart, originally planned for the end of the first quarter of 2023 at the earliest,

has been rescheduled for February 15, 2023. Outokumpu operates three ferrochrome furnaces. The optimization of ferrochrome production based on the price of electricity continues for all three furnaces, and the production capacity remains at 50 – 60% of normal. “The restart of the third ferrochrome furnace gives us more

possibilities for optimizing the production in the current electricity market situation,” says Martti Sassi, President, Business Area Ferrochrome.

■ *Outokumpu*

Outokumpu aims to accelerate energy efficiency improvement

Outokumpu has decided to significantly increase its energy efficiency improvement target and prioritize related investments in 2023 and 2024.

So far, Outokumpu’s target has been to improve energy efficiency by 0.5% annually. The company now aims to improve its energy efficiency by 8% across the group

compared to the January - September 2022 level.

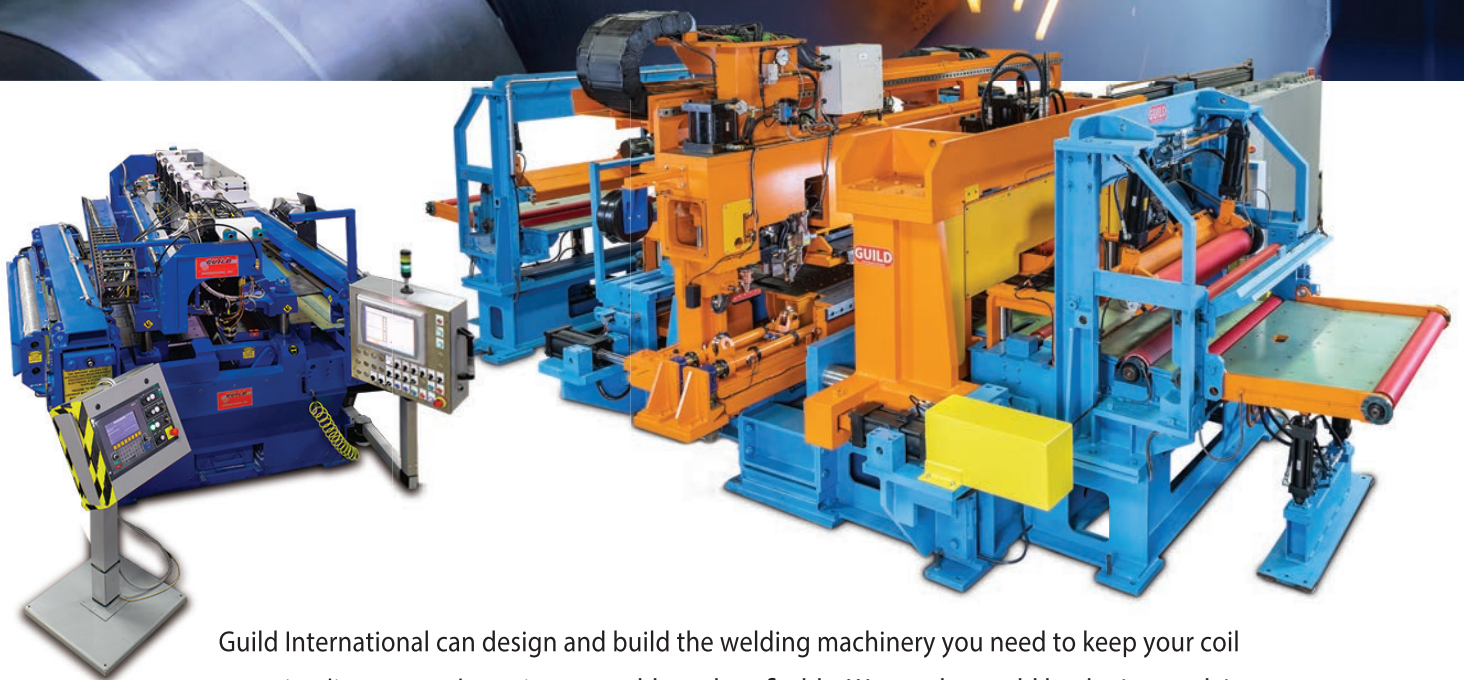
“The European energy crisis has created a turbulent operating environment. To tackle the uncertainty, we have decided to take immediate action on our own energy efficiency. This means that we will prioritize investments to improve our energy efficiency and also increase related annual capital

expenditure by 20 million euros in 2023 and 2024,” says Outokumpu’s Chief Technology Officer Stefan Erdmann. These additional investments do not impact Outokumpu’s capital expenditure frame for the second phase of the strategy by the end of 2025.

■ *Outokumpu*



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EUROPE – ITALY

Acciaierie d'Italia starts up new off-gas cleaning system at sinter plant

Acciaierie d'Italia has started up the new MEROS gas cleaning system supplied by Primetals Technologies at its sinter plants in Taranto. This is the third system of a total of seven ordered by Acciaierie d'Italia.

MEROS off-gas cleaning plants remove almost all potentially harmful substances in waste gases coming from, for example, sinter plants or power plants. At the site in Taranto, the results speak for themselves: the three implemented MEROS plants reduce dust emissions from the two sinter plants to less than 3 mg/m³.

Acciaierie d'Italia has ordered a total of seven MEROS plants from Primetals Technologies, four for the sinter plants and three for the No. 2 power plant. In addition, the dioxin levels are less than 0.01 ng/

m³. During the MEROS process, dust from the sinter plant is treated in a series of steps in which dust and potentially harmful metallic and organic components are removed. As a result, the amount of recir-

culated dust is minimized, which results in fewer filter pulse cleaning cycles and less compressed air consumption.

■ *Primetals Technologies*



Three off-gas cleaning plants from Primetals Technologies have been implemented at Acciaierie d'Italia's site in Taranto. Construction work for an additional four systems started in September 2022

(Photo: Primetals Technologies)

Pittini to expand bar-in-coil production

The Pittini Group has ordered a new line for the production of quality spooled bars in coils from Danieli.

The Danieli K-Spooler technology will be used downstream the existing bar mill in Potenza. Composed of 18 rolling stands, the rolling mill will feed a new 4-pass semi mul-

ti-drive finishing block to initially produce spooled bars in coils of up to 2 t. By adding a K-Weld machine in the future, it will also be possible to produce 5-t coils. The bar diameters will range from 10 to 16 mm. To ensure better and more uniform metallurgical characteristics, the Danieli supply will include a multistage soft quenching pro-

cess. The start-up of the equipment is scheduled for the second quarter of 2024.

In a future second phase of the project, a new two-pass, multi-drive block will be installed to enlarge the diameter range to up to 25 mm.

■ *Danieli*

Siderforgerossi to upgrade ring-rolling mill

Siderforgerossi Group has contracted Danieli to perform an extensive mechanical, electrical and hydraulic overhauling of the 250/200 t radial axial ring-rolling mill in operation at the Arsiero forging shop in Veneto.

The revamping of the ring-rolling mill is part of the overall program of investments

planned by Siderforgerossi Group. The mill will undergo a major renovation, involving mechanical parts, and hydraulic and automation systems, to increase the maximum radial rolling force from 315 to 400 t. This will make it possible to produce rings with improved dimensional accuracy, including near-net-shape titanium casings, and made of high-temperature materials, such as

nickel-based superalloys, e.g. Inconel® 718, for aerospace applications. The new automation system will feature a modern interface and a full set of controls to achieve process efficiency. The revamp is scheduled for completion, with the revamped mill back in operation by the end of 2023.

■ *Danieli*

EUROPE – ITALY

Lucchini RS Group places order for open-die forging press

Lucchini RS Group has awarded Danieli the order to supply a new open-die forging press for its site in Lovere, Bergamo.

The new 7,000 t forging press will be used to enlarge the product portfolio for auto-

motive and industrial applications, while supporting energy and raw-material optimization and cost reduction. The machine frame will comprise four pre-stressed polygonal casings and flat guides on the moving crosshead. Process control will be

integrated with the enterprise management system according to Industry 4.0 standard. The new line is scheduled to start operation by early 2024.

■ *Danieli*

EUROPE – POLAND

ArcelorMittal acquires scrap metal recycling business

ArcelorMittal has signed an agreement to acquire Polish scrap metal recycling business, Zakład Przerobu Żłomu ("Żłomex"). Transaction closing, which is subject to customary regulatory approvals, is expected during the first half of 2023.

Żłomex operates scrap yards in Krakow and Warsaw which last year processed

and shipped almost 400,000 t of ferrous scrap metal. Żłomex supplies a range of steel mills and foundries and has also been a long-standing supplier to ArcelorMittal's steel plants in Dabrowa Górnicza and Warsaw. The company is focused on ferrous scrap metal. In 2022 it expanded its Krakow operations with the installation of a new shredder and separation equipment

and invested in the enlargement of its Warsaw yard.

This is the fourth scrap metal acquisition ArcelorMittal has undertaken in Europe during 2022, as the company continually seeks to enhance its ability to source scrap steel.

■ *ArcelorMittal*

EUROPE – SWEDEN

H2 Green Steel and Mobilaris sign collaboration agreement

H2 Green Steel and digital industrial solutions provider Mobilaris will work together to make use of digital solutions for the world's first large-scale green steel plant.

Mobilaris and H2 Green Steel have signed a letter of intent to collaborate for the use

of digital solutions during construction, and later operations, of H2 Green Steel's large-scale steel plant in Boden in northern Sweden. The ambition of the collaboration between the two companies is to improve workforce safety and provide more efficient site coordination, enabling an efficient, safe and transparent way of

operating a large-scale construction project and later, on daily operations, of a next generation decarbonized steel production plant.

■ *H2 Green Steel / Mobilaris*

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EUROPE – TURKEY

Diler Demir Çelik to increase batch annealing capacity

Diler Demir Çelik has awarded Danieli Olivotto Ferré the order for the supply of heat treatment equipment.

Diler Demir Çelik produces xMnB4, xCr-Mo4, xCr4, 100Cr6 wirerod coils for cold

heading and automotive applications. The steelmaker has decided to double its current heat treatment capacity. The project, performed by Danieli, will bring the total number of bases and heating-bell furnaces to six and four, respectively. The bases will

be designed for a working volume of 4,000 mm in diameter and height, and a maximum charge of 40 t.

■ *Danieli*

Premiere of wire and Tube Eurasia to be staged in Istanbul

The new trade fairs wire Eurasia and Tube Eurasia will be held in Istanbul from 24 to 27 May 2023.

May 2023 will see the two trade fairs Wire Tech Istanbul and Tube + Steel Istanbul being extended to include the new trade

fairs wire and Tube Eurasia, whose focal areas will be wire and cable manufacturing and processing, tubes and pipes production, pipe finishing and trade. wire and Tube Eurasia will initially be run as an investment business venture during Wire Tech Istanbul and Tube + Steel Istanbul

held at the Tüyap Fair Convention and Congress Center. From 2025 wire and Tube Eurasia will then be organized as independent trade fairs at two-year intervals.

■ *Messe Düsseldorf*

EUROPE – UNITED KINGDOM

Tata Steel UK to repair hot-blast stoves

Tata Steel UK has contracted Danieli Corus for the repair of the hot-blast stoves No. 11 and No. 13 at its Port Talbot works.

Hot-blast systems can achieve very long lifetimes if key components such as parts of the vessel shell and the refractories are properly designed, manufactured and

installed. Burner replacements and partial repair jobs are an accepted reality of campaign management. The hot-blast stoves for the blast furnaces at Tata Steel's Port Talbot Works have achieved very long campaign lives thanks to multiple life-extension repairs performed in cooperation with Danieli Corus.

The current contract between Danieli Corus and Tata Steel for the repairs of stove No. 11 at blast furnace No. 4 and stove No. 13 at blast furnace No. 5 is the continuation of the strong relationship between the two companies built over many years.

■ *Danieli Corus*

ResponsibleSteel and global banks agree MoU for rapid decarbonization of steel

The Sustainable Steel Principles Association SSPA and ResponsibleSteel have signaled a continuing desire to cooperate in the interest of complementarity between standards.

ResponsibleSteel is the world's first multi-stakeholder standard for low greenhouse gas emissions and responsibly sourced steel, while the Sustainable Steel Principles provide a methodology for banks to measure and report the emissions associated with their loan portfolios.

Annie Heaton, CEO of ResponsibleSteel said, "With the clock ticking on climate change, we need pragmatic solutions to tackle climate change, especially

in relation to heavy industry. These solutions need to be based on technological breakthroughs, innovation and creative problem solving. They also need to be global. None of this will be possible without a radical step change in how we finance these breakthroughs so industries like steel can decarbonize rapidly and be a force for good."

Both the SSPA and ResponsibleSteel have pragmatic and expert pathways towards rapid sustainability. The Sustainable Steel Principles provide a framework for banks to assess the decarbonization of the steel companies within their portfolios, as well as the climate alignment of their steel lending portfolio. Responsible-

Steel provides an international standard for steel sites to be certified against.

Erik van Doezum, Global Steel Lead at ING and Chair of the SSP said, "The decarbonization of the steel sector globally requires significant investments to be made, and financing will be needed to facilitate these. Banks therefore will have to identify high quality decarbonization business plans. Building consistent and transparent data via reporting requirements for the steel sector will be paramount to facilitating financing for the decarbonization of the sector."

■ *ResponsibleSteel / SSPA*

EUROPE – UNITED KINGDOM

Tata Steel UK completes revamping of continuous annealing line

Tata Steel UK has recommissioned the continuous annealing line at its Trostre Works in Wales after a revamp performed by Danieli Automation.

The project included the replacement of the line's obsolete line automation system, main control cabinets and DC converters for the existing more than 140 strip transportation motors. The project, including the installation activities, was completed in only ten days by several installation teams working 24/7.

Special attention had been paid to preparing the shutdown, starting from site mobilization and prior transportation of a major part of the new equipment within the electrical rooms. Remote connections with plant operators were implemented with the aim to validate in advance all the scenarios based on the actual line behaviour. The commissioning team restarted the line with the new automation system in a very short time, achieving 99.87% line availability performance measured on 14



The Tata Steel and Danieli project teams posing in front of coils processed on the revamped annealing line (Photo: Danieli)

consecutive production days. Final acceptance was obtained according to the contractual schedule. Danieli Automation's engineers will provide support for troubleshooting and additional optimization based

on a remote assistance contract concluded with Tata Steel.

■ *Danieli*

British Steel to install intelligent guide systems

British Steel selected Danieli Morgårdshammar Guide Systems to supply intelligent guides for a 4-strand wirerod mill plant in Scunthorpe, England.

British Steel is investing in a range of intelligent guide products to achieve improvements in production, quality, specification, groove life optimization and safety. The guide types supplied include RX25 guides

to be mounted on stands No. 11 and No. 13, immediately before the Danieli pre-finishing stands. WSG30 guides including a bearing monitoring system will be mounted on stand No. 15. The fast-finishing blocks will be equipped with new roller guides with a bearing monitoring system. Finally, two Smart Eye setting packages will be supplied to optimize setting and alignment.

The mill, which includes a Danieli breakdown mill, produces 1 million t/year of 5.5 to 17-mm-dia. rounds for automotive applications, including tire cord, suspension and valve springs and bridge cables.

■ *Danieli*

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GIFA, METEC, THERMPROCESS AND NEWCAST 2023

ecoMetals Campaign during METEC 2023 exhibition for the metallurgical sector

The metallurgical industry is going to become climate-neutral by 2050 at the latest. This year's quartet of trade fairs from 12 to 16 June 2023 in Düsseldorf will reflect this decisive change. We spoke to Friedrich-Georg Kehrer, Global Portfolio Director at the trade fair organiser.

Mr Kehrer, which trending themes will particularly characterise the technology trade fairs?

Friedrich-Georg Kehrer. How green are the energy-intensive foundry and steel sectors of industry? How sustainably do they produce and how eco-friendly is their use of materials? These are the pivotal questions dominating the agenda and providing ample food for thought at GIFA, METEC, THERMPROCESS and NEWCAST 2023. Tasked with achieving climate neutrality by no later than 2050, these industries face what is probably the biggest transformation in their history.

This decisive development will be reflected by the Düsseldorf trade fair quartet: on the one hand, the challenges that face the sectors; on the other, the innovations that machinery and plant manufacturers offer to the metallurgical and casting industries worldwide clearly making them part of the solution rather than the problem. Through in-depth exchange with the professional bodies and experts from all stages of the value chain we have identified the following three mega trends:

1. Sustainability in the sense of energy and resource efficiency, for instance in the form of green steel or green iron as well as the decarbonisation of the steel and iron industry using hydrogen as a catalyst – summarised succinctly under the “ecoMetals” heading.

2. The use of digital technologies in manufacturing, i.e. that buzzword “Industry 4.0” in steel mills and foundries also remains another mega trend.

3. Furthermore, automotive lightweight construction as well as the latest additive manufacturing processes for steel and metal working continue to play a pivotal role.

With our four trade fairs and the extensive line-up of accompanying events we offer all interested parties a unique platform worldwide to discuss these forward-looking topics in their entire complexity.



Friedrich-Georg Kehrer, Global Portfolio Director at Messe Düsseldorf, Germany
(Picture: Messe Düsseldorf)

What does “ecoMetals” mean and what role does the campaign play in the events?

Friedrich-Georg Kehrer. Messe Düsseldorf's ecoMetals Campaign forms an integral part of the “Bright World of Metals” and is a long-standing success story. It refers to the ecological path of the casting and metal processing industries and promotes exhibiting companies that invest in innovative, sustainable and economically competitive technologies. Trade visitors can easily identify the award-winning innovations and are guided to the respective exhibitors at GIFA, METEC, THERMPRO-

“The innovations that machinery and plant manufacturers offer to the metallurgical and casting industries worldwide clearly making them part of the solution.”

Friedrich-Georg Kehrer, Global Portfolio Director at Messe Düsseldorf

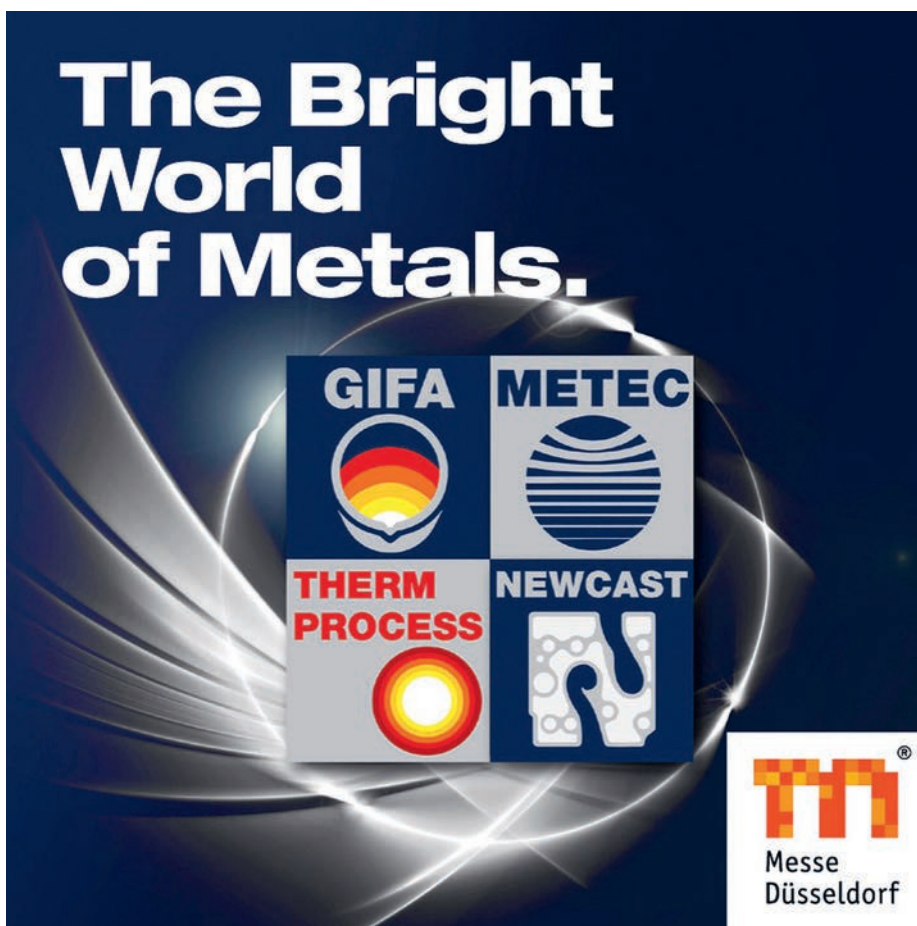
CESS and NEWCAST by way of complimentary daily Guided Tours – so-called ecoMetals Trails.

Furthermore, these exhibitors are especially highlighted in the respective Internet portals as well as in the catalogue and their exhibition stands are signposted. The eco-Metals campaign was already received very well at the previous edition of the trade fair quartet. Our visitors highly appreciated this guidance. I am particularly pleased to see that other capital goods trade fairs such as decarbXpo or wire and Tube have also adopted this concept. With this move we would also like to live up to our ecological responsibility as Messe Düsseldorf and provide the drivers for environment-saving products, production and processes with a special forum.

So the ecoMetals Trails will enable trade visitors to discover “new pathways for value creation” at the trade fairs?

Friedrich-Georg Kehrer. Yes, exactly! The ecoMetals brand focuses on three fields of sustainability: Resources, Innovation and Production and/or Processes. How can raw materials be extracted in a more resource-efficient way and processed more efficiently? What is trending in metal and non-metal recycling? Which novel technologies, machines and plants are used to improve the energy and CO₂-balance? The sustainability drivers exhibiting at GIFA, METEC, THERMPROCESS and NEWCAST will share their solutions for all of these challenges. At their exhibition stands they will explain how they reduce their carbon footprint at their production sites and reconcile business with environmental protection. Overcoming these challenges is as important as ever to hold your own against international competition as a valued business partner.

How much does participation in the ecoMetals Trails cost?



Friedrich-Georg Kehrer. Participation in the Trails is free of charge for all interested visitors. Registrations can be submitted online via the respective Portals in the run-up to the trade fairs. Those deciding on site to take part in a Trail during the trade fair are, of course, just as welcome to do so – also without prior registration.

Can you already reveal any details regarding registration levels? How are the trade fair preparations going in general?

Friedrich-Georg Kehrer. The preparatory work has been completed successfully, many companies have already registered, and the allocation of exhibition space is in full swing. Now the time for finetuning has

come and, of course, for launching visitor canvassing measures. Our exhibitors are eager to inspire the trade fair audience at GIFA, METEC, THERMPROCESS and NEWCAST with their technologies and innovations. All renowned companies will be represented in Düsseldorf again plus many new exhibitors taking part for the first time. GIFA, METEC, THERMPROCESS and NEWCAST are the most relevant events for their respective industries; they thrive on personal encounters and the exchange of ideas in this special setting. Everyone is especially looking forward to this – even more so after such a long time apart!

Thank you for the interview.

THE AMERICAS – BRAZIL

Gerdau Ouro Branco to replace BOF converter

Gerdau has selected Danieli Corus technology and equipment to replace the 224-t BOF converter No. 1 at the Ouro Branco integrated steelworks in Brazil.

The new converter equipment will incorporate a range of improvements to maximize the lifetime. These include high creep-resistance Cr-Mo-material in the vessel's barrel section, increased gap distance between vessel shell and trunnion

ring at both the tapping and charging sides, improved vertical and patented horizontal Daniella-type suspension systems, forced-air draft cooling system for the converter barrel section, multi-circuit water cooling system for the converter top cone and a 16-point online vessel shell-temperature monitoring system.

Danieli Corus will manufacture the converter and the trunnion ring in Danieli Corus certified workshops. The individual

parts and segments will then be transported to Brazil for further pre-assembly at the Ouro Branco site. The first heat with the new BOF converter is scheduled for the summer of 2024.

| Danieli Corus

THE AMERICAS – MEXICO

Frisa to expand product portfolio with rolling mill for big bars

Frisa Steel, a leading Mexican producer of forgings, intends to enter the long product market. To this end, the company has ordered its first long product rolling mill from Danieli.

Danieli will supply technology and equipment for a big-bar rolling mill designed to produce 80 t/h of high-quality rounds and squares in alloy, carbon, tool and stainless steels. The wide range of big bars to be produced will include semi-finished rounds

from 330 to 400 mm and bars and round corner squares of up to 305 mm. The rolling mill will consist of a reversing break-down mill stand followed by an in-line intermediate and finishing mill made of six housingless stands arranged in vertical and horizontal configuration. Finishing services including shears, saws, marking stations, walking-beam cooling bed and slow-cooling stations will complete the mill. An advanced Danieli Automation control system will ensure automatic process settings

and control of the new mill. A Hi-Profile contactless measuring device will check dimensional accuracy and surface quality.

The new facility will be erected at Garcia, Nuevo Leon and will be fed by Frisa Steel's high-quality ingots heated in natural gas furnaces and descaled with high-pressure industrial water before rolling. Plant commissioning is scheduled for the second quarter of 2024.

| Danieli

THE AMERICAS – PERU

Aceros Arequipa implements condition monitoring system in bar rolling mill

Aceros Arequipa has implemented a Danieli CMS to monitor the condition of bearings and gears of its No. 2 rolling mill in operation at its Lima facilities.

The rolling mill produces 800,000 t/year of plain and deformed bars, ranging from 8 to 32-mm dia. The implemented D-CMS is a Danieli-patented system that monitors

the bearings and gears and their conditions, and provides the possibility of forecasting possible damages. Engineering, installation and commissioning of the system took approx. one year, starting from the order. Both commissioning and training activities were carried out remotely. In addition to this, Aceros Arequipa has ordered two other condition monitoring systems from Danieli, for the No.1 and No. 3 rolling mills.

| Danieli

HMI of the condition monitoring system
(Photo: Danieli)



THE AMERICAS – PERU

Aceros Arequipa places order for rebar and merchant bar mill

Aceros Arequipa has selected Danieli as supplier of a new rolling mill for rebar and merchant bars to be installed at its Pisco works.

The new No. 3 rolling mill will be designed to produce a wide range of sections, including flats, angles, channels and tees, rounds, squares and rebars, feeding the finishing lines of the existing No. 1 rolling mill. The project encompasses the engineering, technological supply, on-site training, and advisory services for a walk-

ing-hearth reheating furnace, continuous rolling mill and finishing facilities for rebar and merchant bars.

The reheating furnace, able to process 130-mm and 160-mm square billets of 14 metres length for the production of 330,000 t/year of finished material. The continuous rolling mill, consisting of 18 housingless stands and equipped with hot shears, will be supplied complete with cold-charging devices and furnace exit facilities, such as an induction heater at the entry of the first stand for billet

temperature equalization. A quenching and tempering line will be installed ahead of the dividing shear at the existing cooling bed entry. Upgrading the existing stacker with bar counting devices and bundle storage facilities will complete the supply. The new reheating furnace and the No. 3 rolling mill are expected to be operational at the beginning of 2024.

| Danieli

THE AMERICAS – USA

ArcelorMittal makes major investment in Boston Metal

ArcelorMittal has invested 36 million USD in Boston Metal, based in Woburn, Massachusetts. The transaction is ArcelorMittal's largest single initial investment to date through its XCarb® Innovation Fund.

The fund, launched in March 2021, targets investing in the best and brightest technologies that hold the potential to play a meaningful role in the decarbonization of the steel industry. ArcelorMittal's investment has led a 120 million USD Series C fundraising round undertaken by

Boston Metal. Other participants in the round include Microsoft's Climate Innovation Fund and SiteGround Capital, who join Boston Metal's existing shareholder register which features the likes of Breakthrough Energy Ventures, mining majors Vale and BHP, BMW i Ventures and several cleantech venture capital funds.

Founded in 2013, Boston Metal is developing and commercializing a patented Molten Oxide Electrolysis (MOE) platform for decarbonizing primary steelmaking. MOE uses electricity to produce molten steel through a direct, one-step

process. The MOE cell is capable of processing a wide range of iron ore grades through high temperature electrolysis, producing relatively impurity-free liquid steel with no accompanying CO₂ emissions. As a fully customizable steel manufacturing solution, the modular MOE cells can be scaled until desired production capacity is reached. Boston Metal is targeting commercialization of its technology by 2026.

| ArcelorMittal

THE AMERICAS – USA

Cleveland-Cliffs and United Steelworkers file trade cases

Cleveland-Cliffs Inc. has partnered with the United Steelworkers (USW) in filing antidumping and countervailing duty petitions against eight countries related to unfairly traded tin and chromium coated sheet steel products.

Cleveland-Cliffs produces tin mill products at its Weirton, West Virginia operating facility. The facility employs approximately 950 people, the majority of whom are USW-represented. The petitions seek

the imposition of antidumping duties on U.S. imports of tin mill products from Canada, China, Germany, the Netherlands, South Korea, Taiwan, Turkey, and the United Kingdom. The petitions also seek the imposition of countervailing duties on U.S. imports of tin mill products from China. Census data indicates that, from 2019 to 2021, imports of tin mill products from the subject countries increased by 21%. Subsequently, imports from these subject countries, through

November 2022, increased by an additional 21%. The petitions present evidence that imports of tin mill products from each subject country are being sold in the United States at less than normal value and that imports of tin mill products from China are benefiting from countervailable subsidies.

| Cleveland Cliffs

THE AMERICAS – USA

California Steel Industries to build new galvanizing line

California Steel Industries, Inc. (CSI) will build a continuous galvanizing line at its mill in Fontana, California. With the addition of this new line, CSI will have a total hot-dip galvanizing capacity of 1.2 million t/year.

Nucor acquired a 51% stake in CSI in 2022. The company is a flat-rolled steel

converter with the capability to produce more than 2 million t of finished steel and steel products annually. The new galvanizing line will serve construction end markets in the western United States and is expected to have an annual capacity of 400,000 t. “With recent closures of galvanizing capacity in the western region, CSI is seizing an opportunity to provide

the high-quality value-added products that our customers have requested,” says Leon Topalian, Chair, President and Chief Executive Officer of Nucor Corporation.

■ *Nucor Corporation*

Highbar to build its first rebar mill in Arkansas

Highbar LLC has selected a greenfield site in northeast Arkansas to build the first of its two rebar steel mini mills. The technology for the Highbar mill will be provided by SMS group.

The Highbar mill in northeast Arkansas will sit on over six hundred acres of prop-

erty just outside of the town of Osceola. The project will include space for an expanded Mississippi River port facility, a direct Class 1 railroad connection, and a planned adjacent solar installation. The technology for the mill will be provided by SMS group. Groundbreaking is scheduled to take place in the second quarter

of 2023 once final permits are in place and equipment deliveries begin. A 22-month construction period is planned for the project.

■ *Highbar LLC*

Commercial Metals Company selects site in West Virginia for new micro mill

Commercial Metals Company has selected Berkeley County, West Virginia, as the site of its fourth micro mill. MM4 will be capable of producing various sizes of both straight-length and spooled rebar.

The project is expected to have an annual capacity of 500,000 t. Based on anticipated timelines for permitting and construc-

tion, the new plant is scheduled to begin operations in late 2025.

“MM4 is a core component of CMC’s strategic growth plan and will help ensure our long-term competitiveness in critical geographical markets. We believe this new micro mill, among the most environmentally friendly steelmaking operations in the world, will strengthen our operation-

al network throughout the Eastern U.S. by achieving synergies with our existing mill and downstream facilities,” Barbara R. Smith, Chairperson of the Board, President and Chief Executive Officer, says.

■ *Commercial Metals Company*

Steel Dynamics announces location for planned biocarbon production

Steel Dynamics has selected Columbus, Mississippi, as the location for the initial SDI Biocarbon Solutions biocarbon production operations, a joint venture between the company and Aymium.

The future biocarbon production site is strategically located in close proximity to one of SDI’s largest electric-arc-furnace steel mills, which will consume a significant portion of the biocarbon as a

replacement for anthracite, and is also central to plentiful fiber raw material sources. The new facility will supply Steel Dynamics’ electric arc furnace steel mills with a renewable alternative to fossil fuel-based carbon sources using Aymium’s patented technology. This initial facility’s production capability is expected to be more than 160,000 t/year and operations are planned to begin early 2024.

SDI has successfully trialed Aymium’s biocarbon product in its own steel operations, and estimates this first facility will reduce the company’s Scope 1 steelmaking greenhouse gas emissions intensity between 20 and 25%, with potential upside from the use of the facility’s excess available renewable energy.

■ *Steel Dynamics*

Nucor to construct two flat-rolled galvanizing lines

Nucor is going to construct a galvanizing line at Nucor Steel Berkeley in South Carolina. Additionally, Nucor's Board of Directors approved a galvanizing line to be constructed in the western United States with details to be announced at a future date.

The new South Carolina galvanizing line will have an annual capacity of approxi-

mately 500,000 t and will be able to produce galvanized steel up to 1,830 mm wide. Nucor Steel Berkeley has announced a five-year 200 million USD modernization project, including constructing a new air separation unit to supply industrial gases for the mill's steelmaking operations. Start-up is expected in mid-2025. "The new Berkeley line will complement our recent galvanizing expansions at our Hick-

man and Gallatin operations and will be our eighth wholly-owned galvanizing line," says Leon Topalian, Chair, President and Chief Executive Officer of Nucor Corporation.

■ *Nucor Corporation*

Commercial Metals Company acquires Advanced Steel Recovery

As part of its strategic expansion in the Western U.S., Commercial Metals Company has acquired Advanced Steel Recovery (ASR), leading supplier of recycled ferrous metals located in Southern California.

"The acquisition of ASR is a key strategic step to support CMC's growth in the Western United States," says Barbara

Smith, Chairperson of the Board, President, and Chief Executive Officer. "Our Arizona 2 micro mill remains on-track to startup in early 2023, and with the commencement of operations will come the need for a secure, cost-effective supply of ferrous scrap. ASR's capabilities will help ensure that both of CMC's mills in Arizona will have continued reliable access to vital raw materials."

ASR's primary operations include processing and brokering capabilities that efficiently source material for sale into both the domestic and export markets. ASR handles approximately 300,000 t/year of scrap across its processing, industrial collection, and brokerage platforms.

■ *Commercial Metals Company*

Nucor invests in zero-carbon iron technology start-up

Nucor Corporation has made an equity investment in Electra, a Colorado-based start-up developing a process to produce carbon-free iron that can be used to make steel.

The process developed by Electra produces low-temperature iron (LTI) from com-

mercial and low-grade ores using zero-carbon intermittent electricity. The iron ore is electrochemically refined into pure iron at 60°C using renewable electricity and can be turned into steel using existing electric arc furnaces. Electra uses renewable energy for the electrochemical and hydrometallurgical processes. The material will be

used in the steelmaking process to offset other high-quality metallics that come with higher greenhouse gas emissions. Electra's process results in zero carbon dioxide emissions.

■ *Nucor Corporation*

U. S. Steel builds DR-grade pellet production facility

United States Steel Corporation's investment in direct reduced-grade pellet capabilities marks a step forward in U. S. Steel's metallics strategy.

U. S. Steel broke ground on the facility at its Minnesota Ore Operations Keetac plant in the third quarter of 2022. It is expected

to be operational in late 2023 with first pellets produced in 2024. The new capabilities enable U. S. Steel to supply the increasingly tight DR-grade pellet market and provides the company with the flexibility to feed a potential future direct reduced iron (DRI) or hot briquetted iron (HBI) facility. In addition to producing

DR-grade pellets to ultimately feed EAFs, the production facility will maintain flexibility to continue producing blast furnace grade pellets.

■ *U. S. Steel*

TRANSFORMING EMISSIONS

Steelanol – capture of carbon-rich waste-gases and conversion into ethanol

A new sustainable technology for carbon capture and utilization is now market ready. The Steelanol plant located nearby ArcelorMittal's steel plant in Ghent, Belgium, is fully operational.

On 8 December 2022, ArcelorMittal held an inauguration ceremony for the Steelanol plant located nearby ArcelorMittal's steel plant in Ghent, Belgium. About 800 people gathered for the occasion. Lakshmi Mittal, Executive Chairman at ArcelorMittal took the opportunity to speak about the need for a transition to green technologies in the industry sector.

The Steelanol plant uses the off-gas from the steel plant's blast furnaces to produce ethanol, which then can be used in, for example, sustainable aviation fuel, packaging, and textile production as well as perfumes and household cleaning products. Every ton of ethanol produced at the Steelanol plant will reduce CO₂ emissions by 2.3 tons. The full Life Cycle Assessment (LCA) methodology, based on data from the plant in Ghent, will provide insights into the environmental performance of this type of ethanol.

Thanks to LanzaTech's technology, steel producers can prevent emissions and reuse the carbon from the steel making process to make new products, entering markets beyond steel. The market for recycled carbon products is anticipated to grow quickly over the coming years. Under normal market conditions, this type of plant will pay for itself within a three to five year period and deliver significant return on investment.

Key facts: How ethanol is produced at the Steelanol plant

The concept is a unique fermentation solution that converts previously captured carbon into ethanol, which then is further refined to produce sustainable aviation fuel or other intermediate products for the chemical, textile, or consumer goods industries.



From left: Manfred van Vlierberghe, CEO at ArcelorMittal Belgium, Dr. Alexander Fleischanderl, Senior Vice President and Head of Green Steel at Primetals Technologies, Jennifer Holmgren, CEO at LanzaTech, Dr. Etsuro Hirai, CTO, and Karl Purkarthofer, Head of Metallurgical Services, both with Primetals Technologies

(Picture: Bevas-Styn.be)

Step 1. Waste gas is sent to a compressor unit that increases the pressure to levels required by the bioreactor.

Step 2. Toxic components are removed.

Step 3. The gas is sent to the bioreactor. Here, microbes use carbon monoxide to produce ethanol and other intermediate products.

Step 4. The broth is distilled to reach the required quality.

Step 5. Ethanol and the other intermediate products are stored before being transported to end-users, while the by-products – e.g. water – are cleaned and reused; Steelanol is a zero-waste technology.

Joined decarbonization project

In 2014, the four stakeholders – ArcelorMittal together with LanzaTech, E4tech,

and Primetals Technologies – partnered to develop the Steelanol technology.

ArcelorMittal is the project owner, investor, and coordinator of the project. ArcelorMittal will also operate and maintain the Steelanol plant. **Primetals Technologies** is responsible for engineering and implementing the automation solution, and will provide advisory services for process design and commissioning.

LanzaTech has developed and owns the rights to the technology used at the Steelanol plant. **E4tech** provides the full Life Cycle Assessment (LCA) methodology.

For the construction and startup phases, the Steelanol project has received significant funding from the European Union's Horizon 2020 research and innovation program.

■ *Primetals Technologies*

CARBON CAPTURE IN THE STEEL INDUSTRY

Carbon capture trials at two steel plants in Europe and North America

ArcelorMittal collaborates with partners on a multi-year trial of carbon capture technology. Together they will also conduct a feasibility and design study to support progress to full scale deployment.

ArcelorMittal, the world's leading global steel and mining company, Mitsubishi Heavy Industries Engineering (MHIENG), a pioneer in carbon capture technology, leading global resources company, BHP, along with Mitsubishi Development Pty Ltd are collaborating on a multi-year trial of MHIENG's carbon capture technology with ArcelorMittal, following the signing of a funding agreement between the parties. The companies will also conduct a feasibility and design study to support progress to full scale deployment.

The agreement, which involves a trial at ArcelorMittal's steel plant in Gent, Belgium and another site in North America, brings together the expertise of the various partners in identifying ways to enhance carbon capture and utilisation and/or storage (CCUS) technologies in the hard-to-abate steelmaking industry.

There are no full scale operational CCUS facilities in blast furnace steelmaking operations at present, with only a limited number of small capacity carbon capture or utilisation pilots underway or in the planning phases globally. However, in late 2022 ArcelorMittal Gent commissioned its Steelanol project, a scale demonstration



ArcelorMittal, Mitsubishi Heavy Industries Engineering, BHP and Mitsubishi Development sign collaboration agreement (Picture: ArcelorMittal)

plant that captures carbon-rich process gases from the blast furnace and convert them into ethanol.

To further understand how carbon capture technology can be incorporated into existing steel plants, ArcelorMittal is facilitating the trial at its five million-tonnes-a-year steel plant in Gent, Belgium, and at another location in North America, with MHIENG supplying its proprietary technol-

ogy and supporting the engineering studies. BHP and Mitsubishi Development, as key suppliers of high-quality steelmaking raw materials to ArcelorMittal's European operations, will fund the trial that is anticipated to run for multiple years. In Gent, the trial will have two phases. The first phase involves separating and capturing the CO₂ top gas from the blast furnace at a rate of around 300kg of CO₂ a day – a technical challenge due to the differing levels of contaminants in the top gas. The second phase involves testing the separating and capture of CO₂ from the offgases in the hot strip mill reheating furnace, which burns a mixture of industrial gases including coke oven gas, blast furnace gases and natural gas.

The parties plan to install the mobile test unit in one of ArcelorMittal's North American Direct Reduced Iron (DRI) plants, to test MHIENG's technology in this steelmaking route.

“There is currently no certain or single pathway to net zero for steelmaking. CCUS is one of the key abatement technologies with potential to support development of some of those pathways.”

Vandita Pant, Chief Commercial Officer BHP

MODERNIZATION

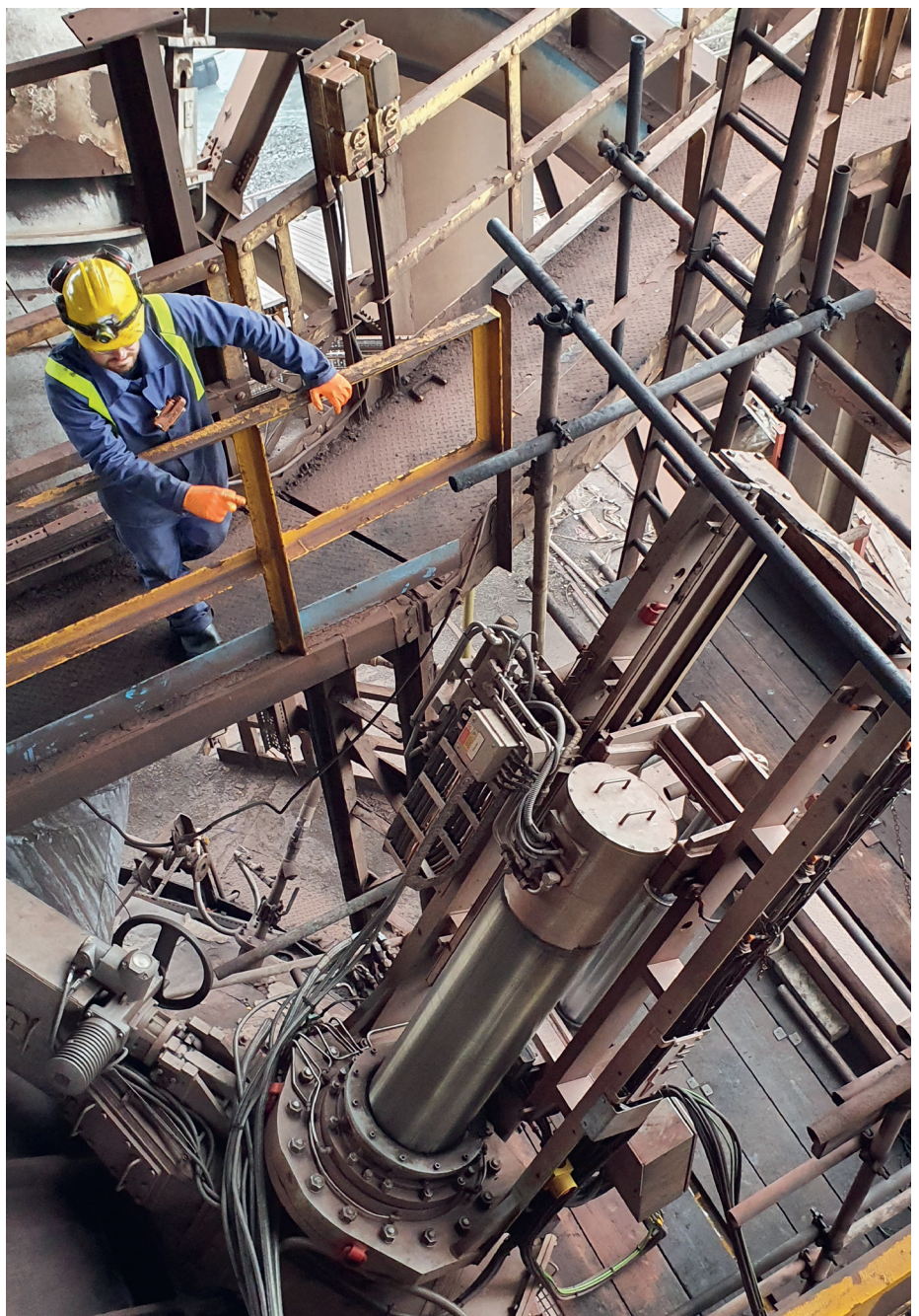
CO₂ savings from Tata Steel's blast furnace improvement programme

The programme will reduce the carbon footprint of the Port Talbot site by about 160,000 tonnes of CO₂ a year. CO₂ savings come from the more efficient use of coke and hot blast gas to reduce the iron ore to hot metal.

Saving about 160,000 tonnes of CO₂ a year – that's equivalent to the annual emissions from nearly 100,000 cars or those from the energy used by around 50,000 households. Within the framework of the programme of improvements Tata Steel UK upgrades some of the hot blast stoves at its blast furnaces. The two Port Talbot furnaces, which currently produce around 3.6 million tonnes of hot metal each year, are powered by high pressure 'hot blast' air that is superheated to temperatures of more than 1,100°C. Recycled on-site process gases (primarily blast furnace gas, enriched with some coke oven gas and natural gas) are used to heat the air in seven refractory-brick-lined 'stoves', before it is injected into the furnaces. Each stove is around 45 m high and 8 m diameter.

Project Manager Andrew McGregor, who is in charge of the improvement programme, said: "Stoves are absolutely critical to the running of our blast furnaces. Any loss of efficiency in heating the air means we either have to use more gas than is optimum, or we have to replace that lost energy by using more metallurgical coke to chemically reduce the iron ore inside the furnaces."

The continuous improvement programme of work in three of the seven stoves will upgrade the burners that generate heat, with two new best available technology units being installed. Many of the refractory bricks that store heat and make hot blast air, are also being replaced. The work is being carried out while the remaining operational stoves are in use. Andrew said: "This programme of activity will make a significant difference to our carbon footprint, our energy costs and our operational stability and efficiency."



Nathan Morris, Electrical Engineer overseeing the installation of the Topscan digital data scanner at Port Talbot's Blast Furnace 5 (Picture: Tata Steel UK)

Million pound digital technology heralds quantum leap

Cutting-edge digital technology is giving Tata Steel technicians an uninterrupted 3D view of the material being laid into the top of its two Port Talbot blast furnaces saving costs, energy and CO₂. The market-leading 'Topscan' technology has the potential to save the company millions of pounds every year by reducing the amount of coke required in the furnaces, and will reduce CO₂ emissions by at least 50,000 tonnes annually. The technology will also play a major role in improving the furnaces' stability and efficiency.

Blast Furnace Technical Manager, Aaron Parsons, said: "The Topscan system

consists of a set of radars which take a full surface scan of the iron ore and metallurgical coke being laid into each furnace, every 10 seconds. Computer modelling then gives us a really clear, finite view of the raw materials at the start of their journey through the furnace. That's really important to us because the specific way in which we lay materials in the furnace is our main method of controlling gas flow up from the hot air blast through the raw materials. Over time, we can make tweaks to the distribution allowing us to make the most efficient use of the hot gases and yield really big savings, both in terms of coke usage and CO₂."

The state-of-the-art unit is very similar to the technology commissioned on Blast

Furnace 4 the year before, which is already delivering invaluable insights and big cost savings and CO₂ reductions. Aaron continued: "This is a massive upgrade from the seven static radars we had previously, from which we had to make assumptions to get a complete picture. Topscan is taking approximately 1,000 data points every 10 seconds, so it's a real quantum leap forward in terms of the data and measurement. Changes to the burden that previously would have taken weeks to analyse and implement can now be done in a matter of hours." The installation of Topscan into Blast Furnace 5 was completed by the end of 2022.

■ *Tata Steel UK*

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RESEARCH & DEVELOPMENT

Study on carbon capture and recycling at blast furnaces to reduce GHG emissions

Researchers from University of Birmingham, U.K., show novel adaptation for existing blast furnaces could drastically reduce CO₂ emissions from the top gas

Researchers from the University of Birmingham, U.K., have designed a novel adaptation for existing iron and steel furnaces that could reduce carbon dioxide (CO₂) emissions from the steelmaking industry by nearly 90%. This radical reduction is achieved through a 'closed loop' carbon recycling system, which could replace 90% of the coke typically used in current blast furnace-basic oxygen furnace systems and produces oxygen as a byproduct.

The novel recycling system captures the CO₂ from the top gas and reduces it to CO using a crystalline mineral lattice known as a 'perovskite' material. The material was chosen as the reactions take place within a range of temperatures (700-800°C) that can be powered by renewable energy sources and/or generated using heat exchangers connected to the blast furnaces.

Under a high concentration of CO₂, the perovskite splits CO₂ into oxygen, which is absorbed into the lattice, and CO, which is fed back into the blast furnace. The perovskite can be regenerated to its original form in a chemical reaction that takes place in a low oxygen environment. The oxygen produced can be used in the basic oxygen furnace to produce steel.

The new system can be retrofitted to existing furnaces, with the addition of an array of additional gas separators and heat



"The system we are proposing can be retrofitted to existing plants, which reduces the risk of stranded assets, and both the reduction in CO₂, and the cost savings, are seen immediately."

Professor Yulong Ding, School of Chemical Engineering



exchangers required to support the perovskite splitter.

Devised by Professor Yulong Ding and Dr Harriet Kildahl from the University of Birmingham's School of Chemical Engineering, the system is detailed in a paper published in the *Journal of Cleaner Production*, which shows that if implemented in the UK alone, it could deliver cost savings of £1.28 billion in 5 years while reducing overall UK emissions by 2.9%.

Professor Ding said: "Current proposals for decarbonising the steel sector rely on phasing out existing plants and introducing electric arc furnaces powered by renewable electricity. However, an electric arc furnace plant can cost over £1 billion to build, which makes this switch economically unfeasible in the time remaining to meet the Paris Climate Agreement. The system we are proposing can be retrofitted to existing plants,

which reduces the risk of stranded assets, and both the reduction in CO₂, and the cost savings, are seen immediately."

University of Birmingham Enterprise has filed a patent application covering the system and its use in metal production and is looking for long-term partners to participate in pilot studies, deliver this technology to existing infrastructure, or collaborate on further research to develop the system.

University of Birmingham Enterprise

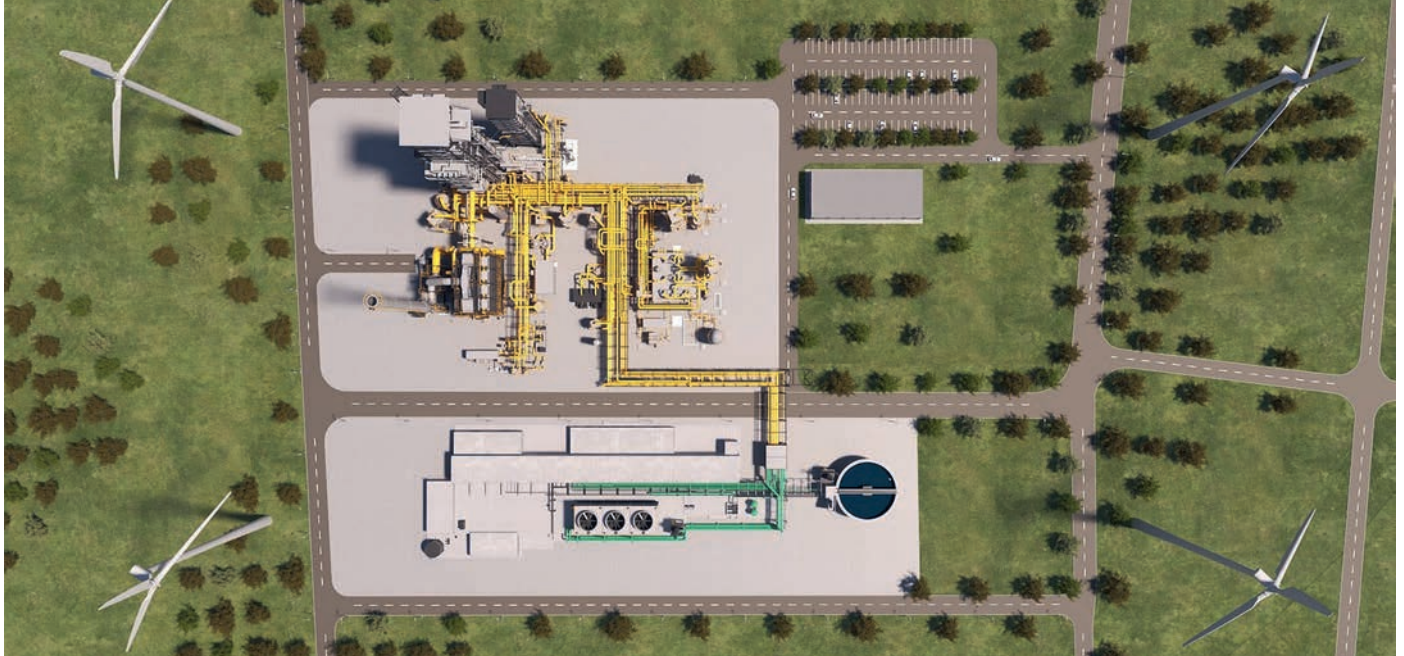
Reference

Harriet Kildahl, Li Wang, Lige Tong, Yulong Ding: Cost effective decarbonisation of blast furnace – basic oxygen furnace steel production through thermochemical sector coupling. In: *Journal of Cleaner Production*, Volume 389, 2023, 135963 (available at: <https://t1p.de/wojr5>)

Most of the world's steel is produced via blast furnaces. The process is inherently carbon intensive, using metallurgical coke produced by destructive distillation of coal in a coke oven, which reacts with the oxygen in the hot air blast to produce carbon monoxide. This reacts with the iron ore in the blast furnace to produce hot metal and CO₂. The top gas from the blast furnace contains mainly nitrogen, CO and CO₂, which is burned to raise the air blast temperature up to 1200

to 1350°C in a hot blast stove (cowper) before blown to the furnace, with the CO₂ and N₂ (also containing NO_x) emitted to the environment.

Iron and steelmaking is the biggest emitter of CO₂ of all foundation industrial sectors, accounting for 9% of global emissions. According to the International Renewable Energy Agency (IRENA), it must achieve a 90% reduction in emissions by 2050 to limit global warming to 1.5°C.



Draft plan for the new production facilities at ArcelorMittal Dofasco (Picture: Danieli)

TRANSITION TO DRI-EAF STEELMAKING AT NORTH AMERICAN FLAT STEEL FRANCHISE

First transformational low-carbon emissions steelmaking project

At ArcelorMittal Dofasco in Canada the first onsite construction work has started with the demolition of the decommissioned No. 1 coke plant to make room for the new Energiron direct reduction plant

In October 2022 ArcelorMittal broke ground on its CAD\$1.8 billion investment decarbonisation project at the ArcelorMittal Dofasco plant in Hamilton, Ontario, Canada. The governments of Canada and Ontario having committed CAD\$400 million and CAD\$500 million respectively to the overall project cost.

The project will fundamentally change the way steel is made at ArcelorMittal Dofasco, transitioning the site to direct reduced iron-electric arc furnace ('DRI-EAF') steelmaking, which carries a considerably lower carbon footprint and removes coal from the ironmaking process.

Energiron technology, jointly developed by Tenova and Danieli, has been chosen as its DRI equipment. It will produce 2.5 million tonnes of DRI per year. The DRI plant will initially operate on natural gas but will be constructed 'hydrogen ready' so it can be transitioned to utilise green hydrogen as a clean energy input as and when a sufficient, cost-effective supply of green hydrogen becomes available.

Hot DRI pellets will be processed at a new meltshop to be located next to the Energiron plant. The new EAF will be capable of producing 2.4 million tonnes of

high-quality steel through ArcelorMittal Dofasco's existing casting, rolling and finishing facilities. Modification of the existing EAF facility and continuous casters will also be undertaken to align productivity, quality and energy capabilities between all assets in the new footprint.

months to complete, and foundation work to begin in 2024. Construction will become visible from outside the manufacturing campus in 2024. Construction on the new assets will be complete in 2026, at which point a 12 to 18-month transition phase will begin which both streams (BF-BOF

“This project will enable us to make significant progress this decade, reduce our emissions in Hamilton by approximately 60 per cent and lay strong foundations for near zero steelmaking.”

Lakshmi Mittal, Chairman of ArcelorMittal

The first onsite construction work has started in January 2023, with the demolition of the decommissioned No.1 Coke Plant to make room for the new DRI plant. Demolition is anticipated to take up to nine

and DRI-EAF) will be active and is expected to be completed by 2028.

ArcelorMittal/Danieli/Tenova

ZERO IMPACT ON THE POWER GRID AND THE POSSIBILITY TO USE RENEWABLE ENERGIES

Competitive, green steelmaking using the Digimelter technology

Digimelter® is a Danieli-patented technology with a unique combination of power, intelligence, and environmentally friendly equipment for achieving 15,000 heats per year with minimal OpEx, lowest environmental impacts, and high flexibility for raw materials



Digimelter® is recognized by the market as the new benchmark technology for electric steelmaking to melt scrap / DRI

(Picture: Danieli)

Electric arc furnace technology has seen a continuous evolution in the last 50 years, towards increased efficiency, with electric energy consumption halved, tap-to-tap time reduced by four times, and electrodes consumption reduced more than five times. These results have been achieved thanks to a combination of chemical packages (oxygen blowing, burners), design improvement (water cooled walls, EBT, lances, bottom stirring) and enhanced process controls.

Another important trend has been the increase in average power for individual furnaces, which has led to the develop-

ment of Ultra High Power EAFs capable of producing in excess of 360 tons per hour of steel.

Electric arc furnaces have a powerful impact on electric grids: the more powerful the EAF, the more severe are the effects on the grid, with consequences like flicker, a phenomenon characterized by quick voltage variations that are visible in bulbs (flickering) and that can negatively affect power electronics, such as inverters in a rolling mill or similar processes. The arc furnace also impacts harmonic distortion and power factors with possible significant voltage drops, again impacting

all plant auxiliaries, in the worst cases causing machine stoppages.

Many solutions have been developed over the years to dynamically compensate for such disturbances, namely SVCs (Static Var Compensator) and VSCs (Voltage Source Converter). These are high-power electronic systems designed to superimpose controlled reactive power to mitigate the impact of furnace disturbances.

The possible solutions for electric power transfer to the arc were the AC furnace and DC furnace. While the AC furnaces are the most common technology applied, where arc voltage and current are con-

trolled thanks to the positioning of electrodes, DC furnaces use rectifiers to impose the current of the arc, but with some significant implications for equipment design and related maintenance.

DC furnace technology reduces flicker generation and improves furnace control but requires a different and more expensive mechanical and electrical design. Therefore, DC furnaces are more maintenance-intensive and the bottom shell refractories require much more attention.

Digimelter for scrap/DRI

Digimelter® is the Danieli answer for modern, clean, competitive, sustainable green steelmaking, recognized by the market as the new benchmark technology for electric steelmaking to melt scrap / DRI.

It is a Danieli-patented technology with a unique combination of power, intelligence, and environmentally friendly equipment for achieving 15,000 heats per year with minimal OpEx, lowest environmental impacts, and high flexibility for raw materials.

The **Q-ONE electrical feeder** provides the highest power factor and very low network flicker due to real-time arc control. It achieves unprecedented high-power transfer thanks to independent control of arc current, voltage, and frequency, for each electrode.

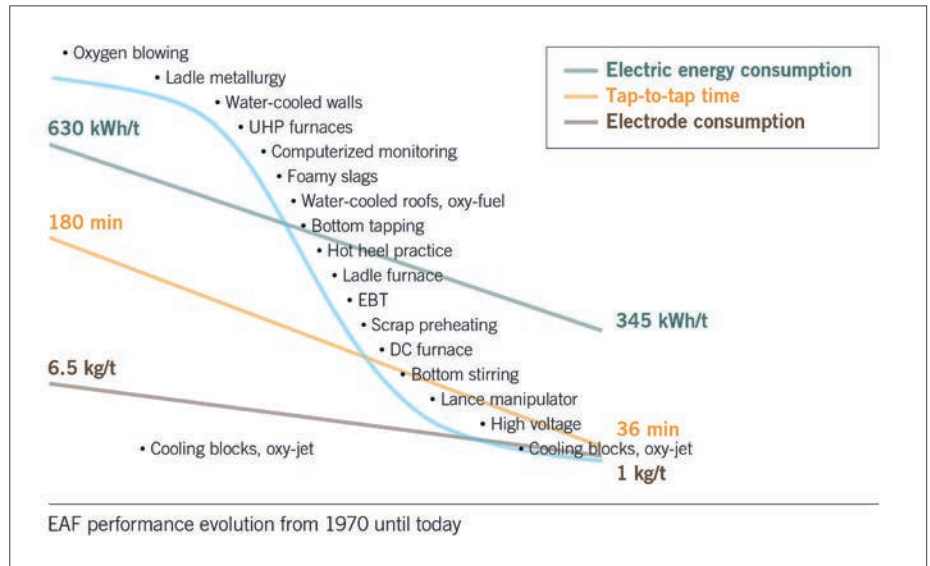
The **Q-Melt intelligent controller** runs EAF melting processes automatically, in a stable and adaptive way by making use of Q-Reg+ electrode regulator, Lindarc laser off-gas analyzer, and Melt-Model self-learning optimizer.

The **Zero-bucket concept** is accomplished by the ECS continuous scrap charging and preheating system as well as continuous hot DRI feeding from the roof, for reduced environmental impact and enhanced energy saving.

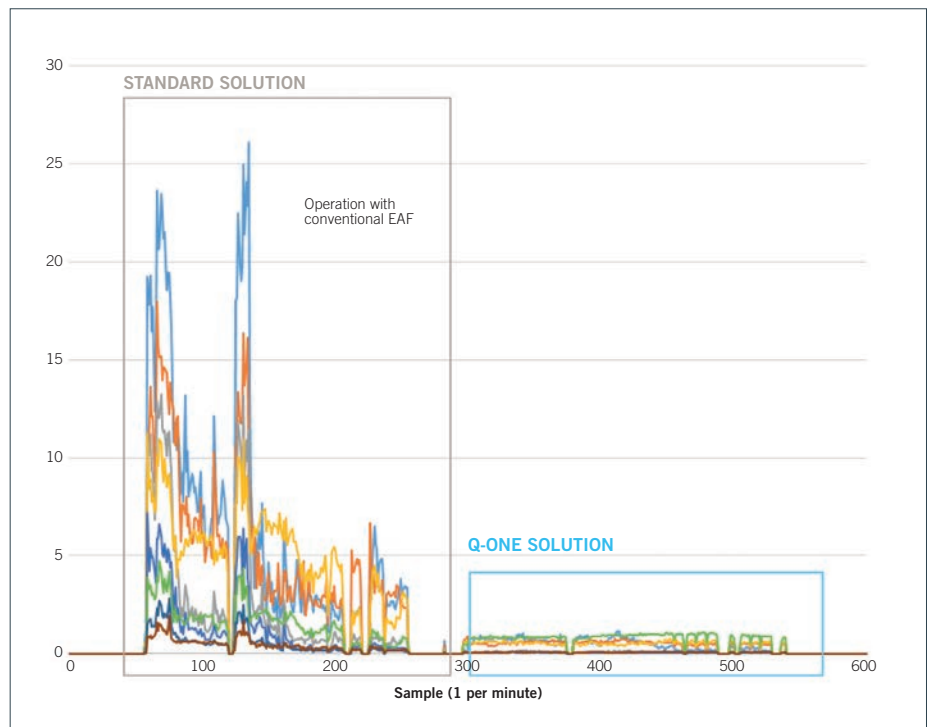
The **Eco-Pro airtight design** is conceived to reduce pollutants to the minimum. Compared to a conventional EAF with the same charge mix, Digimelter® Eco-Pro reduces the CO₂ direct emissions (Scope 1) by more than 50% and overall CO₂ emissions (Scope 2) by 25%.

Q-One, a breakthrough technology.

Q-One is the Danieli Automation patented, key technology at the basis of the Digimelter® concept. In 2016 Danieli Automation installed the first Q-One, the first industri-



Electric arc furnace technology has seen a continuous evolution in the last 50 years (Picture: Danieli)



EAFs have a powerful impact on electric grids. Q-One allows furnace operation with negligible effect to the power network (Picture: Danieli)

alized application of power electronics to control electric arc current and voltage in the EAF. In other words, using the conventional furnace design, this solution can impose arc current, with the consequent benefits in process stability and reducing drastically the impact on the connecting electric network.

In fact, Q-One operates with a power factor at medium voltage above 0.96, gen-

erating a very low flicker, avoiding use of compensation systems also because harmonic generation is well below IEEE limits.

The system is modular by design: not only can the power required by the process be adjusted by selecting the number of modules, but also the solution can be designed for progressive growth in stages, meaning that initial power can be



Digimelter® EAF with continuous scrap feeding and charging
(Picture: Danieli)

increased just by adding modules in a second stage.

This modularity also improves reliability and plant availability, considering the possibility to keep melting at reduced power (disabling one module) or even with two phases only instead of three.

High availability is a must, and that's why modules also have been designed with the same components and inverters, which minimizes the quantity and value of spare parts. The digital control allows for remote monitoring and troubleshooting.

The working points are no longer discrete, dictated by the taps on a transformer, but can be chosen freely according to process needs.

One additional degree of freedom is given by the change of frequency, possible only in arc furnaces adopting Q-One. A frequency higher than network nominal improves arc stability and therefore is used during the boring stage, while a frequency below nominal, down to 20 Hz – as commonly used today – is ideal for reducing energy consumption in the refining stage and for deeper penetration of the arc in the molten bath, as well as to induce a beneficial stirring effect on the molten steel.

Lower frequency means a lower inductive reactance and consequently a lower consumption. Results from the field prove

that up to 10% extra energy savings come from the low-frequency operation.

The control of arc current implies a much more stable operation of the furnace, visible during melting, due to the absence of cooled-cables swaying and electrodes oscillating. The outcome is reduced electrode consumption, up to 15%, and at least 20% longer refractory life.

Q-Melt automatic furnace. The unique, reliable, and flexible green power solution of Q-One also benefits from Artificial Intelligence – AI applications and advanced control solutions. Danieli Q-Melt advanced process control offers dynamic and automatic optimization of the melting profile. The system has been designed with the Danieli Intelligent Plant architecture for continuous learning and improvement of the process.

In addition, Q-Melt furnace automation is fully integrated upstream with an automatic scrap-yard management system in order to optimize melting process control for accurate and consistent working points set-up and quality assignment. To conclude, the control pulpit is ergonomically designed to integrate human expertise and machine precision to achieve unique performances and superior quality with best cost strategy.

Most important, these results are achieved with a no-man-on-the-floor philosophy, powered by the advanced automation and the adoption of robots in the field to perform dangerous and repetitive operations, to achieve safe operation in steelmaking.

Zerobucket® ECS. Danieli Zerobucket EAF is the most environmentally friendly melting technology with the lowest CO₂ footprint. Characterized by high flexibility in raw materials, low energy consumption, very high reliability and utilization factor, lowest noise and pollution emissions, Danieli Digimelter® Zerobucket with ECS horizontal continuous charging system is the perfect answer to the latest needs of the steelmaking market. A very stable and smooth process allows the operators to easily bring the system to optimized operating conditions, reducing the risks of delays and providing extremely fast learning curve.

Zerobucket® Hytemp. The Hytemp pneumatic transport is the most efficient way to deliver hot DRI to the EAF at > 600°C with no dust losses. It has been in operation since 1998 at four reference installations (Ternium, Emirates Steel #1, Emirates Steel #2 and Suez Steel), and about

40 million tons of DRI have been transported up to now. It shows outstanding reliability and availability close to 100%, with very low maintenance requirements. It is fully integrated with the DRP and Q-Melt™ furnace control systems, and matches the highest safety standards thanks to the inert carrier gas and the completely sealed design.

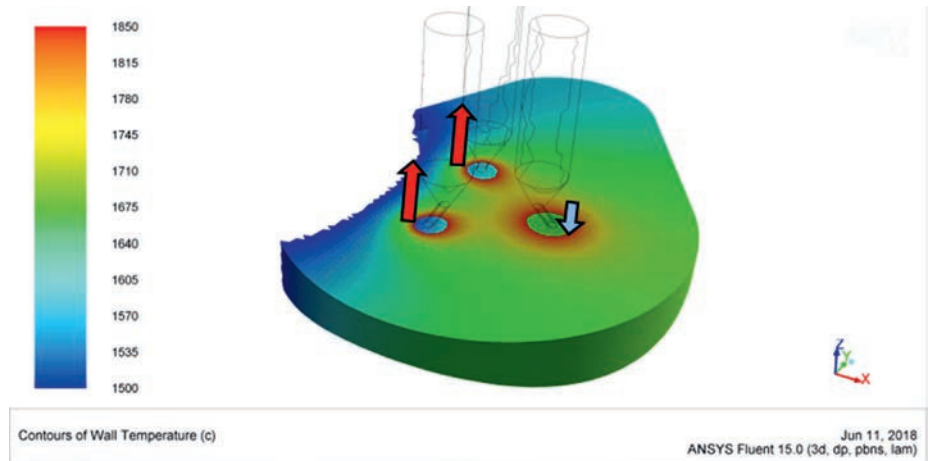
Eco-Pro airtight design. The Digimelter® Eco-Pro airtight design is conceived to reduce to the minimum the emissions of pollutants and to minimize the CO₂ equivalent. Every detail of the Digimelter® has been carefully optimized in order to minimize air inlet to the melting area. The furnace is kept always sealed, thanks also to the Thor 3K automatic slag door and improved sealing between the furnace and the ECS conveyor.

The process itself is controlled automatically by the Q-Melt suite, leading to a minimization of oxygen and carbon injection, ensuring the most efficient melting at the lowest CO₂ footprint. Compared to a conventional EAF with the same charge mix, Digimelter® Eco-Pro reduces the CO₂ direct emissions (Scope 1) by more than 50% and overall CO₂ emissions (Scope 2) by 25%.

Hybrid-ready by design, perfect for transition

Digimelter® fits very well the sustainable approach to steelmaking, thanks to the possibility to connect the DC Link to renewable energy sources, such as photovoltaic but also hydro or wind power, using the Q-One power feeder. With hybrid feeding, the OpEx of a furnace would be further improved, not to mention the reduction of its carbon footprint. A software suite, named Q3-Jenius, has been designed to manage the different available sources, depending on their cost and availability, with consideration also of forecast energy consumption for the specific products.

Having a very low impact on the grid, the Digimelter® represents an ideal solution for the decarbonization path, considering new arc furnaces melting scrap / DRI in place of blast furnaces. In fact, the electric network close to integrated plants typically was not designed to supply high volumes of electric power, required by arc melting, and the impact of traditional



The control of the arc current implies a much more stable operation of the furnace

(Picture: Danieli)

transformer EAF solutions on the electric grid is critical.

With Q-One, even for high-power furnaces, in most cases there is no need for any additional compensation system to meet the electric authority requirements.

Furthermore, the modularity of the Q-One makes it suitable for the furnace evolution "in phases," where hot metal can be charged in high percentages in a first phase, while DRI and scrap will be mainly used, with higher power requirements, in a second stage.

Orders for EAF transition from BF

The industrial transition from ironmaking to electric steelmaking has started, with **Algoma Steel** in December 2021. It was the world-first steelmaker to convert fully from BF to EAF steelmaking, for 70% CO₂ reduction. To be installed at Sault Ste. Marie, Ontario, Canada, and started by early 2024, the new, green steel shop will have a design capacity of 3.7 million t/year of liquid steel.

Algoma Steel will operate two, 250-t Danieli Digimelters®, powered by two Q-One digital power systems with a rated capacity in excess of 190 MVA each. The design provides for best-in-class environmental performance with engineered enclosures for the two furnaces to minimize noise and emissions, while the Q-Melt automatic process control will deliver superior energy efficiency. Two new, off-gas treatment plants including baghouses and a dedicated recirculating water treatment plant will combine to provide best available technology for emis-

sion control and filtration, and water conservation.

Liberty Ostrava was the first in Europe to make the step from ironmaking with electric steelmaking in 2022. Two Danieli Digimelters® having a combined capacity of 3.2 million t/year will be installed at the Ostrava steelworks in Czech Republic, and start operation in 2025. With a target emission reduction of 80%, this is the first step for Liberty towards carbon neutrality.

In the initial phase of the project the two 200-t Digimelters® will replace Ostrava's existing four, tandem steelmaking furnaces (oxygen converters) and perform decarburization with flexible inputs of hot metal and scrap charges ranging from 80-20% to 60-40%. Starting from 2027, thanks to an enhanced electrical network, the furnaces will be able to melt HBI, DRI and scrap mixes, and up to 100% scrap, by fully exploiting Digimelter® strengths. Powered by Q-One, Digimelter® will ensure an almost negligible impact on the power network.

Both steelmakers chose the performance and reliability of Danieli Digimelter® for the first technology transitions in the world.

Digimelter® installations being part of Danieli MIDA minimills

Together with high-speed casting and Danieli Universal Direct Rolling, Digimelter® is one of the key technologies of the Danieli MIDA minimills for long and flat products.

Due to the tangible advantages, the latest MIDA minimill orders such those from



Zerobucket® ECS continuous scrap charge is characterized by low energy consumption, lowest noise and pollution emissions

(Picture: Danieli)

CMC Steel, Bashundara, Pacific Steel, Nucor Steel, Tata Steel and Unitex, incorporate Digimelter®.

CMC Steel Arizona 2 / USA. This is the first plant in the world to produce merchant bars in endless mode. To be put in operation in early 2023 in Arizona, CMC Steel Arizona 2 is the third Danieli MIDA QLP minimill for CMC Steel and will produce 500,000 t/year of rebar and small merchant sections. Hybrid-ready, it will melt local scrap by the innovative Danieli Digimelter® (Q-One, Zerobucket, Q-Melt) and produce in endless casting and rolling mode. It will feature a patented layout specifically developed to fully match the needs of merchant products in terms of high plant uptime and excellent yield.

Bashundhara / Bangladesh. The jumbo QLP® minimill is designed to produce 1 million t/year bars and wirerod. Being installed in Chittagong and started up by mid-2023, Bashundhara minimill was designed with the latest, highly efficient and environmentally friendly technologies.

Danieli Digimelter® – ready for connection to renewable energies – will melt scrap continuously charged and preheated by Danieli ECS system. Straight rebar, ribbed and smooth wirerod will be produced in endless casting and rolling mode through a single-strand, 150-t/hour Octocaster® featuring FCC® and octagonal section, starting from mid 2023.

Pacific Steel Group / USA. The world first MIDA-QLP® hybrid minimill featuring Q-One® and Q-Jenius will make use of solar energy. To be installed in Mojave, California and start operation by early 2025, the new MIDA Hybrid endless casting-rolling minimill will produce 380,000 shtpy of straight and spooled rebar in the most efficient and ecological way. Fed by a continuous charge system, the scrap will be processed through Digimelter® and LF digital melting and refining units, powered by the Q-One digital power feeder which ensures the best power conditions at different frequencies. Hybrid by design, Q-One will make use of solar energy generated on site, through Q-Jenius. This is a

fully automated plant, starting from automatic scrap management through final product tracking, featuring Q3-Met manufacturing execution system for production scheduling and tracking, for maximum plant efficiency.

Nucor Steel / USA. It is the third order from Nucor for a MIDA-QLP® endless casting-rolling minimill for rebar. A new MIDA-QLP to produce 410,000 short tons per year of quality rebars from recycled steel scrap will be installed in Lexington, North Carolina. It will feature Digimelter® and LF powered by Q-One® digital power feeder, with the possibility to utilize renewable energies. A single-strand, high-productivity Octocaster® will feed the rolling mill in full endless mode. Managed by Danieli Automation's advanced process technologies and artificial intelligence, the minimill will incorporate Q3 pulpits to support operators in supervising a fully automated plant, making extensive use of big-data analysis. Robotized solutions will increase plant safety according to the "zero-man on the floor" concept. Handled

by a Q3-Met manufacturing execution system, production will start by summer 2024.

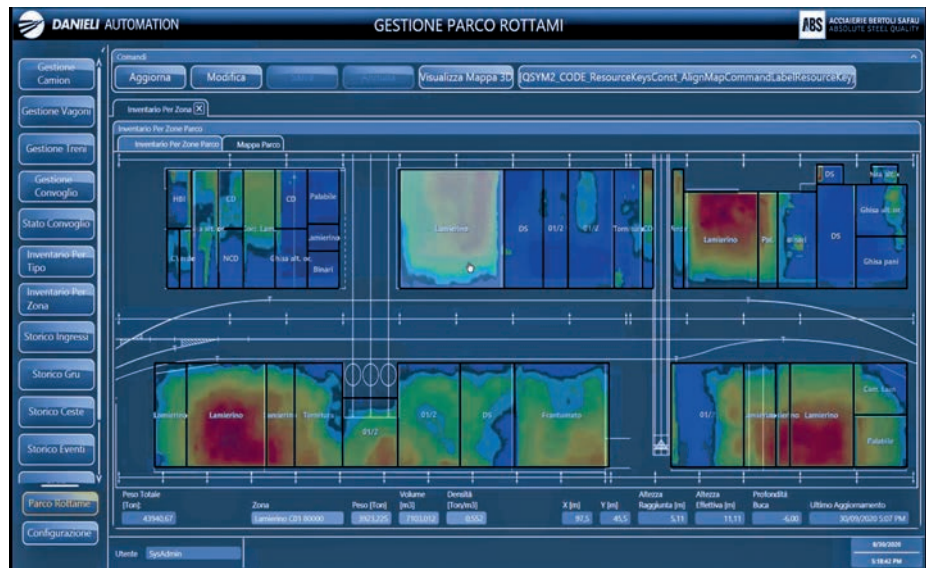
Tata Steel / India. 750,000 t/year of quality rebar produced in a sustainable way thanks to Digimelter® and endless casting-rolling. The investment in a Danieli MIDA Hybrid QLP minimill for the production of long products is part of the Tata Steel commitment to invest in a circular economy and to transition to low-carbon steelmaking through the steel recycling route.

The new MIDA QLP ordered by Tata Steel will be installed in the North of India, in Ludhiana, Punjab, and produce quality rebar, mainly in 550 SD grade. The minimill will feature the Danieli-patented Digimelter® (Q-One hybrid power feeder + Zero-bucket scrap charge system + Q-Melt advanced process control suite) and Octocaster® feeding an ultra-compact rolling mill. The start of operation is planned by the end of 2024. Tata Steel order is Danieli endless casting rolling plant #22.

Unitex Steel / Bangladesh. 1-million t/year minimill for bars and light sections will feature Digimelter® melting unit with continuous hot charge. A complete minimill, including auxiliary plants for fumes and water treatment as well as the most advanced electrical and automation systems, to guarantee continuous and reliable production. A highly efficient, 100-t Digimelter® featuring Q-One digital power feeder and ECS continuous-scrap charging and preheating systems will competitively melt scrap. A four-strand, quality conticaster featuring FastCast Cube™ oscillator, Eco-Power Mould™ and EMS, will feed a super-flexible merchant rolling mill in hot-charge mode. To be installed in the Feni district of Chittagong, in the eastern region of Bangladesh, the minimill is scheduled to be started up in Q4 2024.

Q-One for meltshop upgrades

Q-One also is very suitable for meltshop upgrades, including those that need renovation to boost productivity and performances. It is applicable to both EAFs and LFs and provides increased power input and operation savings in terms of electric power and electrodes, along with zero impact on the power grid and related benefits.



Q-Melt furnace automation is fully integrated upstream with an automatic scrap-yard management system (Picture: Danieli)

The first EAF upgrade dates back to 2016. Then, in 2019 at an 80-ton capacity furnace at ABS Sisak, Croatia, +10% productivity, -8% energy consumption and -15% electrodes consumption were achieved. The latest order is from Cognor, Poland for the upgrade of a 48-ton EAF.

The first ladle furnace upgraded to Q-One power feeder is in operation at Tokyo Steel since mid 2021, having a capacity of 125 tons, and that of CMC Steel Arizona 1 at the Danieli MIDA minimill operating since early 2022, confirms the smooth and quick startup already performed at Tokyo Steel.

Scrap optimization and management

Q-Melt interfaces with the Danieli Automation Q-SYM2 advanced, unmanned, upstream AI scrap-optimization and management system. Q-SYM2 automatic scrap management system provides the furnace with best classified raw material and scrap processing machine interaction according to EAF/scrap bay needs.

Scrap is mapped from its arrival to the bay at the steelmaking plant to its use in the furnace, to ensure the incoming material quality and quantity according to the purchase order.

Real-time tracking allows for prompt, effective and simplified claim procedures when needed, thanks to artificial intelligence that makes possible automatic image acquisition and analysis.

Real-time scrap inventory is made continuously available, reducing human errors and operational times. Scrap tracking handles scrap movement within the yard including loading and unloading bays.

A native integration within the overhead cranes improves the yard management yield. Accurate “crane mission-generation” results in optimized crane utilization, with repetitive actions promptly executed based on scheduled and predetermined patterns.

Conclusion

The Danieli Digimelter®, powered by the patented and innovative Q-One, represents the best available solution for the substitution of blast furnaces/BOFs with electric arc furnaces of 300 tons and more.

Thanks to the unique power control on the arc, Q-One allows for a new approach to the melting process, with frequency control and freedom of choice on working points, minimizing the impact on the grid, achieving minimum OpEx for furnace operation, with hybrid feeding, intelligent process controls and safe operation. In other words, it is the only solution to be a step ahead. Of course, Digimelter® is also widely used in modern minimills to enjoy the benefits of melting efficiency, reduced energy and electrode consumption.

Danieli

NEW METHOD OF ELECTRIC STEELMAKING TO REDUCE CO₂ EMISSIONS

Liberty Steel UK launches ecoke

Liberty Steel UK has successfully completed trials of ecoke – a sustainable new raw material that can replace anthracite, the main source of charge carbon in electric steelmaking

The ecoke initiative is part of Liberty’s drive to lead transformation of steel manufacturing through its Greensteel strategy. Production at Liberty’s electric arc furnace (EAF) in Rotherham (South Yorkshire, England) generates just 10% of the direct emissions compared with traditional coal-based blast furnaces which produce the vast majority of the UK’s steel output.

Liberty Steel UK’s steelmaking team at Aldwarke Cast Products (ACP) in Rotherham performed a review of the processes to identify opportunities to reduce its CO₂ emissions. The team identified anthracite as the main source of charge carbon in electric arc furnace production – accounting for between 86 and 97%.

A steering team was formed in Rotherham to replace anthracite with environmentally sustainable alternative. The group considered all available options and finally identified CPL Industries as local supplier of biofuel called ecoke.

Ecoke contains a minimum of 30% secondary biomass giving a CO₂ reduction of 30%. The briquettes are delivered to site



The briquettes are delivered to site in similar packaging to the anthracite and ecoke is charged into the EAF in the same manner via the scrap basket (Picture: Liberty Steel)

in similar packaging to the anthracite and ecoke is charged into the electric arc furnace in the same manner as the anthracite via the scrap basket providing an ideal solution for steelmaking operations.

The trials open up an immense opportunity both within Liberty’s business and potentially in other areas of the steel industry worldwide. In addition to the environmental benefits, the reduction in carbon credits would provide a substantial cost saving for the company.

Scott Jackson, Plant Manager at ACP of Liberty Speciality Steel said: “The success of Liberty’s ecoke trials is a major

step forward for our Greensteel strategy. The major reductions in CO₂ emissions ecoke enables, without any downside to the production process, can help to further decarbonise our production and the wider steel industry.”

Jason Sutton, CEO of CPL Industries Solid Fuels, said: “We are very proud to support Liberty’s Greensteel initiative: Liberty Steel is at the vanguard of decarbonisation strategies in steel, we quickly identified a natural fit and an opportunity to develop a strategic partnership between two major employers in the Yorkshire and Humber region. Ecoke provides an immediate path to decarbonisation, and we are committed to a programme of product development and investment to deliver further advances in biofuels in order to exceed industry expectations for the coming years”.



The steelmaking team at Aldwarke Cast Products (ACP) in Rotherham successfully completed the trials of ecoke as a substitute for anthracite in electric steelmaking (Picture: Liberty Steel)

| Liberty Steel Group



Nucor colleagues look forward to providing sustainable plate products for the US military, infrastructure, heavy equipment, offshore wind, and other markets (Picture: Danieli)

TAILWINDS EXPECTED FROM THE US INFLATION REDUCTION ACT

Nucor Steel Brandenburg plate mill rolls first plate

The project of the new flat steel complex at Brandenburg, Kentucky/USA, along the Ohio River, is in progress, and according to schedule the first plate was rolled at the end of 2022

Nucor's new state-of-the-art steel plate mill in Brandenburg, Kentucky/USA, rolled its first steel plate on Friday, December 30, 2022. Nucor Steel Brandenburg is now focusing on final commissioning of the mill in the first quarter of 2023 and will ship the first products to customers during the quarter.

"We have achieved an important milestone and executed one of the safest mill start-ups in Nucor history," said Leon Topalian, Chair, President, and Chief Executive Officer of Nucor Corporation. Nucor Steel Brandenburg will be among only a few mills globally – and the only mill in the United States – capable of manufacturing at scale the heavy gauge plate used in monopile foundations for offshore wind towers. As a result, it will be a critical part of the supply chain for the continued development of our nation's offshore wind power infrastructure. The recent passage of the Inflation Reduction Act supports the Biden Administration's announced goal to build 30 gigawatts of offshore wind power

by 2030. This could result in approximately 7.5 million short tons (6.8 million t) of additional steel demand.

The Nucor Steel Brandenburg plate mill is a US\$1.7 billion capital investment in specialized capabilities with the ability to produce 1.2 million short tons (1.09 million t) annually. The new mill is located in the middle of the largest steel plate-consuming region in the country and will be able to produce 97% of plate products consumed domestically. According to Nucor it is also the first steel mill in the world to pursue certification under LEED v4 ("Leadership in Energy and Environmental Design"), which is more stringent than previous LEED rating systems and provides a globally recognized framework for sustainability achievement.

Plate/Steckel mill complex for quality plates

Supported by advanced automation and featuring two heavy-duty stands, the Dan-

ieli mill will allow Nucor Steel Brandenburg to produce thermo-mechanical rolled plates up to 168" (4,267 mm) wide and coils up to 125" (3,175 mm) wide. An EVO 5 hot leveler designed for two different types of cassettes, and a plate finishing and shearing line for the handling and cutting of 250-ft (76 m) mother plates, will complete the mill that soon shall become the new benchmark plant of the sector.

Also, the meltshop at Brandenburg features Danieli EAF Q-Melt and Zero Man Turn Around, ladle metallurgy furnace (LMF) and VD twin-stations ensuring precise chemistry and temperature control, whilst minimizing transformation costs.

■ Nucor / Danieli

AFRICA – ALGERIA

AQS upgrades steel complex

AQS (Algerian-Qatari Steel) has contracted Danieli for an upgrade of its mini-mill complex for long products located in the industrial area of Bellara, Willaya of Jijel.

The complex consists of two meltshops, two bar rolling mills and a wirod mill. It produces 2 million t/year of finished products from steel scrap. No. 1 rolling mill, a

bar mill operating in the hot-charge mode and producing 16 to 40 mm-diameter products, will be upgraded with the installation of additional equipment to be able to also produce smaller sizes, such as 12 and 14 mm diameters on two strands. The new equipment includes a new convertible stand, four new gearboxes and a two-strand water quenching and tempering box.

Furthermore, the five-strand No. 1 billet caster will be equipped with new moulds and with a secondary cooling system to cast 130 mm square billets in addition to 150 mm square. The new equipment is planned to be installed by the fourth quarter of 2024.

| Danieli

AFRICA – UGANDA

Roofings Rolling Mills expands cold strip capacity

Roofings Rolling Mills has placed the order for its cold-strip capacity and product portfolio expansion with Danieli. The project includes a new cold-rolling mill and hot-dip galvanizing, colour-coating and side-trimming lines.

The equipment will be installed partially at the existing site and partially in a new, nearby building, in Kampala. The investment will allow Roofings to produce an additional 100,000 t/year of galvanized

coils and 50,000 t/year of painted coils in an efficient and ecological way.

Danieli will supply the complete mechanical, hydraulic, electrical and automation equipment. The single-stand cold-reversing mill will be equipped with heavy-duty positive/negative bending and ultrafast HAGC control to achieve excellent thickness tolerances. Advanced automation will allow superior performances in terms of product quality and productivity.

The hot-dip galvanizing line will feature the Danieli Kohler X-jet gas wiping system. The colour-coating line will come with Danieli Fata Hunter chemical and paint coaters and catenary-type prime and finish ovens. Danieli Automation will provide the electric and automation systems including Level 1 and Level 2. The facility is scheduled to go on stream by mid 2024.

| Danieli

ASIA – BANGLADESH

Bashundhara Multisteel places order for integrated hot-rolled coil facility

Bashundhara Multisteel Industries has signed a contract with SMS group to install an integrated hot-rolled coil production facility.

With the new integrated CSP® plant, Bashundhara Multisteel Industries, the steel division of Bashundhara Group, will be able to produce more than 2 million t per year of hot rolled coils. The facility's capacity will be expandable to 4 million t per year in the future. SMS group will install the state-of-the-art CSP® facility upstream of the meltshop along with auxiliaries. The new facility will help filling the gap in the growing demand for flat products in Bangladesh.

| SMS group



Safwan Sobhan (right), Vice Chairman Bashundhara Group, shaking hands with Burkhard Dahmen, Chairman of the Managing Board & CEO, SMS group, during contract signing at Dhaka (Photo: SMS group)

ASIA – CHINA

Tube China to take place in parallel with Metal + Metallurgy 2023

The leading trade fair for the regional tube and pipe industry will be staged in Shanghai from 14 to 16 June 2023 concurrently with the Metal + Metallurgy China trade show.

The Tube China exhibition will showcase machinery and equipment for tube manufacturing, processing technologies, raw materials, tubes and accessories, pipeline and OCTG technology. Visitors to Tube China come primarily from the automotive, chemical, and oil and gas industries, the

energy sector, aerospace technology and the construction industry. Further information on the trade fair can be found at: www.tubechina.net.

■ *Messe Düsseldorf*

wire China 2023 to be staged in September

The new dates for the wire China trade fair have been announced. The leading regional trade fair for the wire and cable industry will take place from 4 to 7 September 2023 at the Shanghai New International Expo Centre (SNIEC).

The event will focus on wire and cable production and processing equipment as well as innovations in wire and cable products. The four-day event, jointly organized by Messe Düsseldorf Shanghai and the Shanghai Electric Cable Research Institute

since 2004, will be accompanied by conferences and workshops. Further information on the event is available at www.wirechina.net.

■ *Messe Düsseldorf*

Jiangsu Shagang to reline blast furnace

Jiangsu Shagang has awarded Danieli Corus a contract to revamp its 5,800 m³ blast furnace in operation at Zhangjiagang in the Jiangsu province.

The furnace lining zones will be converted from copper stave cooling to the Danieli Corus design based on high conductivity graphite refractories in combination with machined copper plate coolers. This is the

third time Danieli Corus blast furnace cooling and lining technology will be implemented in China.

■ *Danieli Corus*

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ASIA – CHINA

Baowu Masteel replaces BOF converters with EAF steelmaking

At its Changjiang facilities, Baowu Masteel has brought on stream the new Danieli-supplied electric arc furnace.

The new FastArc ECS Zero-Bucket® electric arc furnace at Baowu Masteel Chang-

jiang is in operation. The 140-t UHP Ultra-High Power EAF features the original Danieli endless charging system for continuous scrap charging and preheating, while up to 85% of hot metal is charged via a dedicated pouring system. The Pal-

mur supersonic wall lance plays a key role in this process. It allows faster slag foaming during the first phase of melting on a large percentage of the scrap charge and guarantees a fast steel decarburization rate. The high degree of automation minimizes operational costs. Performance after 1,180 heats after the hot start-up is better than contractually agreed.

| Danieli



The new electric arc furnace in operation at Baowu Masteel Changjiang.
(Photo: Danieli)

Baowu orders cold rolling mills

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 at the Baoshan and Wuhan production sites.

Fives will supply two DMS 20Hi EcoMills for the production of grain-oriented, high permeability and non-grain oriented electric steel. The mill for the Baoshan site will

be a split housing mill, and for the Wuhan site, a monobloc mill. Thanks to its portfolio of different technologies, Fives is able to offer tailored cold rolling mill solutions to both Baoshan and Wuhan production sites according to their specific operation and maintenance practices. 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.

Both mills will feature the proprietary RollBot™ technology, a fully automatic roll change system that performs fast, precise and safe roll change without any manual intervention, ensuring optimal safety and product quality.

| Fives

ASIA – INDIA

Tata Steel to build new SQB complex in Jamshedpur

Tata Steel Long Products has ordered equipment from Danieli and Kocks for its new SBQ bar and wire rod mill to be built in Jamshedpur.

The new mill will have a capacity of 500,000 t/year of bar and wire rod. It will be designed to produce round bars from 20 to 90 mm diameter and wire rod from 5.5 to 25 mm diameter.

The bar mill supplied by Danieli will consist of a reversible stand followed by 12 housingless stands arranged in H-V configuration, a cooling bed equipped with hardness control by insulated covers and complete bar finishing services. For the wire rod line, Danieli will supply an 8-pass finishing block and a TMB twin-module block followed by a controlled cooling conveyor and a coil handling system.

The order for Friedrich Kocks covers a reducing & sizing block RSB® 370++/4(5) in 5.0 design. The block will be located as finishing unit after the reversing mill. Kocks will also supply the roll shop equipment.

| Danieli / Kocks

ASIA – INDIA

Tata Steel signs MoUs to achieve carbon neutrality goal

Tata Steel is prioritizing decarbonization and is looking for solutions to achieve carbon neutrality by 2045. In support of this goal, Tata has signed memorandums of understanding with Primetals Technologies and SMS group.

Tata Steel aims to intensify the collaboration on projects and technology related to green steel and decarbonization with Primetals Technologies and SMS group.

Under the MoU, Primetals Technologies will provide engineering expertise as well as support in implementing green steel technology. The MoU with SMS group focuses on reducing carbon emissions at Tata's integrated steel plants across India. SMS group will contribute its technological expertise in designing, supplying and commissioning plants with significantly lower CO₂ emissions. Burkhard Dahmen, CEO and Chairman of SMS



Signing of the MoU between SMS group and Tata Steel (Photo: SMS group)

group, said: "Our companies have a common goal to reduce carbon emissions from iron and steel production, as the industry is not only key to economic prosperity, it is also one of the largest CO₂ emitters. We are therefore very proud to

team up with Tata Steel and are committed to supporting the company with its decarbonization roadmap."

■ Primetals Technologies / SMS group

Tata Steel orders long-product minimill

As part of Tata Steel's commitment to invest in a circular economy and to transition to low-carbon steelmaking through the steel recycling route, the steelmaker is going to build a minimill for long products based on the Danieli MIDA Hybrid QLP technology.

The new mill complex will be installed in the North of India, in Ludhiana, Punjab, and will have an annual capacity of 750,000 t of quality rebar, mainly in 550 SD grade. It is scheduled to be operational by the end of 2024.

The minimill will feature the Danieli-patented Digimelter, a single-strand Octocaster and a compact rolling mill. The 75-t Zerobucket Digimelter will receive preheated scrap from the continuous scrap-charging and preheating system. The Danieli Q-Melt advanced process control offers dynamic and automatic optimization of the melting profile.

For endless casting-rolling, the single-strand caster will be connected to the rolling mill for uninterrupted production. The 18-stand rolling mill featuring two 6-pass, fast-finishing blocks will roll rebar ranging from 8 to 40 mm dia.

■ Danieli

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ASIA – JAPAN

Shinkansai to implement EAF power feeding system

Flat steel producer Shinkansai Steel Co. will implement the Danieli Q-One technology on the electric arc furnace at its Sakai plant.

Designed by Danieli Automation, the Q-One power feeding system uses the latest digital power electronics technology to maintain the EAF power-factor values close to unity. It will have a five-unit configuration with a total maximum power of 54.6 MVA.

Controlling and keeping the electrical current, voltage and frequency at optimal



levels throughout the melting process reduces both electricity and electrode consumption, hence operational expenditures. With the Q-One system in place, Shinkansai's EAF will not require a static var compensation system. The project is expected to be completed by autumn of 2024.

| Danieli

Shake hands after the contract signing ceremony between Shinkansai Steel and Danieli (Photo: Danieli)

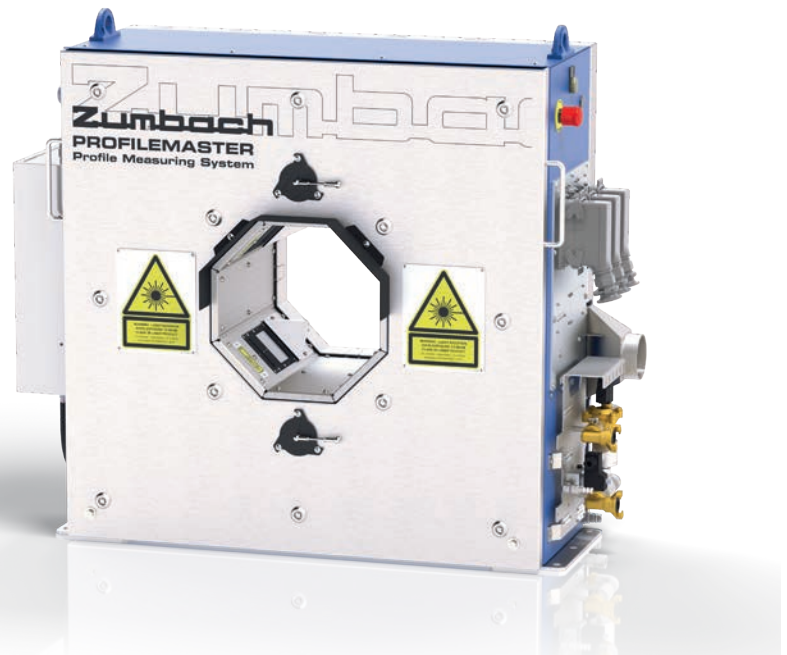
In-line profile measurement and monitoring systems

The application of the Profilemaster SPS systems has been adapted to serve specific measurement, monitoring and surface flaw detection under harsh environments of rolling mills for hot and cold steel rods, bars, profiles and much more.

Main features of the systems are as following:

- › Provides 100% inspection in real time
- › Reduces start-up time
- › Increases the repeatability and precision of your end product
- › Improves process control
- › Reduces scrap
- › Saves raw material and post processing costs
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- › Integrates in a seamless way to your network or higher-level systems
- › Simple cleaning requirements, giving short maintenance needs
- › Logging of all production data for QC department
- › Makes post production measurements irrelevant
- › Surface fault detection (SFD) thanks to high sampling rate
- › Compilation of a 3D model thanks to high sampling rate
- › Reliable operation in harsh conditions, product temperatures up to 1200°C

Profilemaster systems are available with 4 up to 8 laser/camera modules and different measuring field sizes to cover product dimensions from 5 mm (.2 in.) up to



Profilemaster® SPS from Zumbach

720 mm (28.3 in.). The cross section of a moving profile can be measured continuously by combining the images of the individual cameras. All relevant dimensions such as width, height, angle and radius or other geometric quantities are displayed in an operator-friendly graphical user interface. The nominal profile shape can be directly imported from CAD design files (DXF), which allows a simple configuration of the device. Changes in speed and twist within normal limits have no influence on the measurement precision.

As a pioneer of on-line measurement committed to extensive research and development activities, Zumbach Electronics has continuously grown as one of the worldwide leading manufacturers of in-line measuring and control systems. Top priority at Zumbach Electronics remains to be customer relationships through local presence combined with proven high-quality products, services, personal consulting and support.

| Zumbach Electronic AG



Figure 1. Hydraulic radial forging machine in operation (Picture: SMS group)

FORGING TECHNOLOGY SUITE

Advanced pass-schedule design in radial forging through novel process models

The newly developed process model ComForge® Property Predictor which is part of the forging technology suite ComForge® is capable of simulating the temperature and strain distribution in radial forging within seconds for any given pass-schedule

Radial forging is a highly efficient metal forming process, where the workpiece is deformed by four surrounding dies to the intended final shape. Besides achieving a certain final geometry, radial forging furthermore aims at excellent mechanical properties, which have to be ensured by the adequate choice of forging parameters. The main targets in radial forging can be summarized as follows:

- › Maximum process efficiency: short forging times and energy saving by avoiding reheating cycles,
- › Improvement of the microstructure: ensure sufficient deformation in the workpiece's core and surface for a fine-grained recrystallized microstructure,

- › Closure of pores and voids from casting: closing and welding of inner pores to prevent the formation of cracks.

The hydraulic radial forging machine SMX by SMS group has been a success story for more than 30 years, where the defining feature of the SMX is given by the hydraulic drive of the four forging dies. Compared to the conventional mechanically driven system, the hydraulic drive offers the significant advantage with regard to the forging process and workpiece quality that the full forging force is available over the entire stroke of each forging cylinder. Hence, a good core penetration as well as flexible forging strategies with a controlled movement of the dies becomes possible.

In general, radial forging is applied for a large variety of materials, which include the following most-relevant material classes:

- › carbon steel, e.g. C45,
- › tempering steel, e.g. 42CrMo4 (AISI 4140 or 1.7225),
- › stainless steel, e.g. X5CrNi18-10 (= AISI 304 or 1.4301),
- › hot-working steel, e.g. X38CrMoV5-1 (= AISI H11 or 1.2343),
- › nickel-base alloy, e.g. Inconel 718 (N07718 or 2.4668),
- › titanium, e.g. Ti-6-4 (ASTM Grade 5).

Due to material costs, especially the forging of Ni-base alloys and titanium requires detailed process design and precise execution of the forging operation. Final geom-

Dr. Martin Wolfgarten, Dr. Frederik Knauf, SMS group GmbH, Moenchengladbach, Germany



Figure 2. Close-up view of the radial forging process (Picture: SMS group)

eries in radial forging are mainly round bars as well as rectangular cross-section and stepped shafts.

Forging Technology Suite – new step in pass schedule design

To support operators from pass schedule calculation to material properties optimization the existing technology software ComForge® is transferred into to a forging technology suite now covering all extensions of ComForge®, like

- > ComForge® PassSchedule Calculator,
- > ComForge® PassSchedule Analyzer,
- > ComForge® Property Predictor

and will be continuously developed further in the future.

ComForge® PassSchedule Calculator.

Since its introduction with the first SMX radial forging machine more than 30 years ago, ComForge® has proven to be an efficient and powerful tool for creating pass-schedules. ComForge® allows ensuring a consistent high level of production quality by addressing the main challenges in process design:

- > increase productivity to maximum performance,
- > minimum tolerances,
- > high reproducibility with detailed documentation.

Within the new forging technology suite, the known ComForge® is re-named as ComForge® PassSchedule Calculator. With data on over 200 materials, the ComForge® forging technology suite has everything required for calculating relevant forging schedules for all customers. This provides plant owners with a comprehen-

sive database for trouble-free and technologically proven forging processes. After calculation, the pass-schedule is directly transferred to the PLC of the SMX and finally fully automated executed. Here, ComForge® PassSchedule Calculator offers various forging strategies for the production of round, square and rectangular bars using different tool sets. To ensure a precise prediction of the forging time and the resulting productivity, the characteristics of the machine’s hydraulic are directly implemented into ComForge® PassSchedule Calculator.

Challenges in pass-schedule design in radial forging

Nowadays, radial forging processes are mainly designed based on the experience and knowledge of the operator or geometry based pass-schedule calculation, which SMS provides with their established software ComForge® PassSchedule Calculator. Although this allows a well-proven analysis on the process sequence, forces and kinematics, it gives only a statement on the geometrical evolution of the workpiece and does not provide any further information e.g. on the distribution of equivalent strain or temperature.

On the other hand, a numerical simulation of open-die forging process using FEA is complex, requires large numerical effort as well as personnel with technological knowledge and is very time consuming,

since forging processes usually consist of up to many hundred forming steps. Hence, the process design in radial forging is often very time-consuming, expensive and leads to pass-schedules, where too large safety margins e.g. regarding the temperature are chosen resulting in a reduced profitability.

To overcome this challenge and improve the process of radial forging, SMS group hereby presents the newly developed software ComForge® Property Predictor, which is capable to calculate the temperature and deformation for a given pass-schedule within seconds.

ComForge® Property Predictor – advanced process modelling

ComForge® Property Predictor describes a stand-alone advanced technology software, which is part of the forging technology suite ComForge® allowing a detailed calculation and analysis of radial forging processes regarding the material properties:

- > calculation and visualization of the strain distribution along the cross-section of the workpiece,
- > calculation of the temperature distribution in the cross-section considering radiation, convection, tool contact as well as heating through dissipation.

Temperature calculation. The principle of temperature modelling is based on the

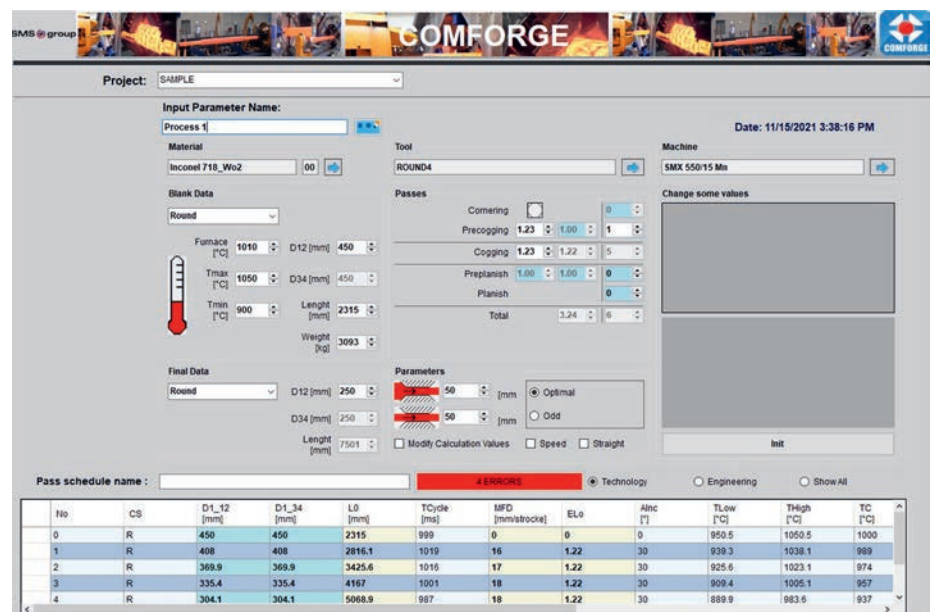


Figure 3. Graphical user interface of ComForge® PassSchedule Calculator (Picture: SMS group)



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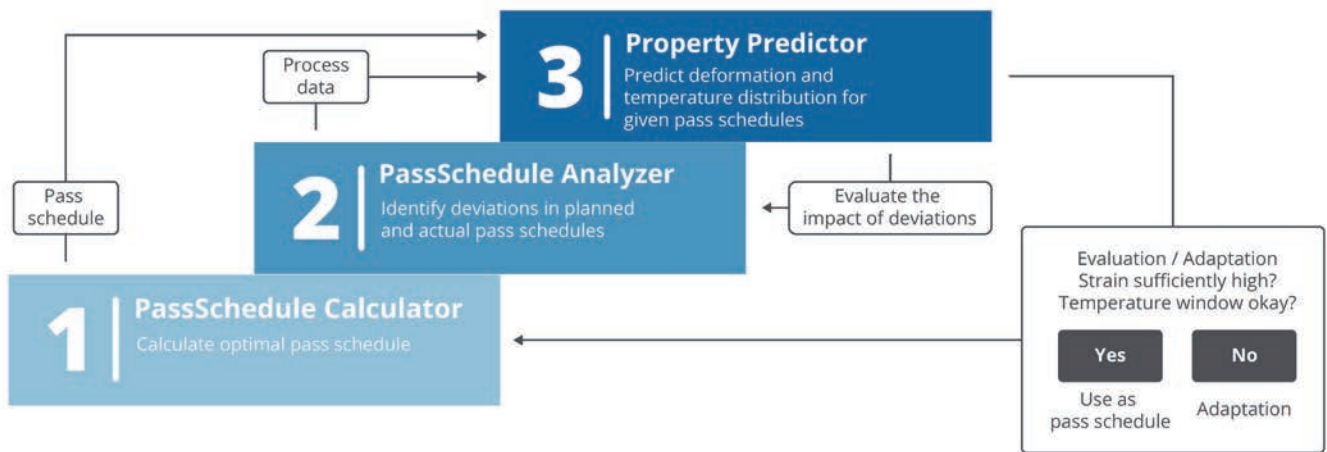


Figure 4. From process analyzing to material properties optimization (Picture: SMS group)

Finite-Difference Method (FDM). The workpiece is divided in nodes. For every node, the temperature is calculated using an explicit Finite-difference scheme, considering radiation, convection, cooling due to tool contact while forging and dissipation, i.e. heating by deformation.

Calculation of deformation and equivalent strain. Ensuring a sufficiently large deformation, especially in the core fibre of the ingot, is of high importance for the material quality. In radial forging, the strain distribution is mainly influenced by elongation, manipulator feed per stroke (MFD) and turning angle. For the calculation, the strain distribution is described based on an analytical function, where all of these parameters are taken fully into account. The progression of the deformation for the radius can be calculated for the entire cross section. The strain model is available for all above-mentioned material classes, where additional material groups or alloys can be implemented upon request.

Coupling with the other ComForge® extensions. ComForge® Property Predictor is designed as stand-alone technology solution but can be directly coupled with ComForge® PassSchedule Calculator, so that for any pass-schedule designed with ComForge® Pass Schedule Calculator the temperature and strain distribution can be evaluated within seconds.

ComForge® Property Predictor® offers the following main application cases. In the stage of process design, for any pass-schedule as calculated by ComForge® Pass Schedule Calculator, strain

and temperature can be analysed in detail to check, whether the designed forging process fulfils all requirements regarding strain and temperature.

ComForge® Property Predictor can be easily used for employee training since it directly allows evaluation of the impact of different forging parameters on the workpiece quality.

Together with the ComForge® Pass Schedule Calculator, ComForge® Property Predictor can be widely applied for process optimization. After calculation, the pass schedule is used as input data for ComForge® Property Predictor as schematically visualized in figure 4. Based on this knowledge, the forging technologist can adapt the parameter of the pass-schedule and evaluate the effect of the forging parameter on the resulting strain and tem-

perature distribution. Further benefits of ComForge® Property Predictor are:

- No special FE-simulation software is required, saving high license fees.
- Due to the total integration within the forging technology suite, a simple data transfer directly within ComForge® is possible. It can be handled by process engineer, so that no simulation specialist is required.
- Due to the fast modelling of the strain and temperature, very short simulation times (less than 1 minute) are possible.

Use case: process quality

When designing a new forging sequence of Inconel 718, the following questions arise:

Table 1. Pass schedule #1 (process time without planishing: 330 seconds)

Pass No.	d ₁	Feed	Elong.	Turning angel
1	390mm	38mm	1.33	30°
2	340mm	40mm	1.32	30°
3	290mm	40mm	1.37	30°
4	240mm	50mm	1.46	30°
5	200mm	65mm	1.44	30°
6 (Planishing)	200mm	20mm	1.00	11°
Average without planishing:		42mm	1.39	
Start: Ø 450 mm x 1,500 mm; final dimension: Ø 200 mm x 7,594 mm				
Material: Inconel 718; furnace temperature: 1,100°C				

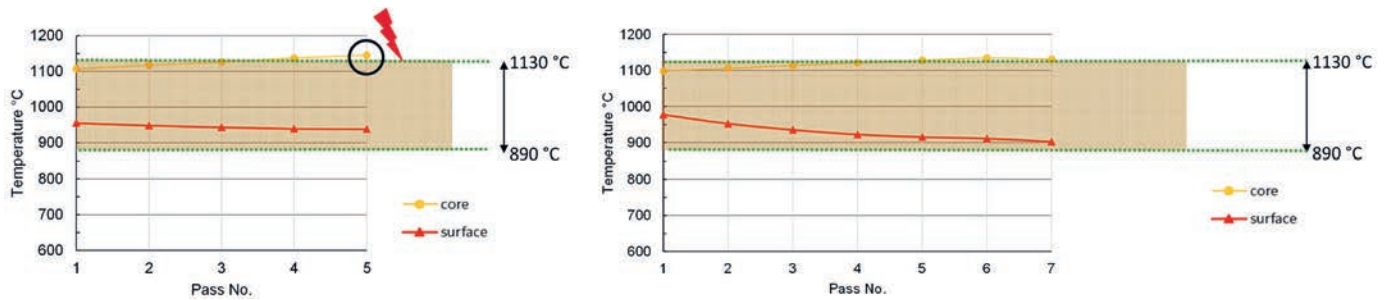


Figure 5. Visualization of core and surface temperature after calculation with ComForge® Property Predictor (Picture: SMS group)

- Is it possible to forge the ingot within one heat or is a reheating of the ingot required?
- How large is the adiabatic heating of the core to control critical grain growth?

Using the forging technology suite ComForge® and the common forging parameters for Inconel 718, a first the pass-schedule is generated by ComForge® Pass Schedule Calculator (depending on machine parameters) as shown at **table 1**. In the next step, ComForge Property Predictor® is used to calculate the resulting temperature distribution at core and surface, where the result is shown in **figure 5** (left). The planishing operation is not considered due to its small amount of deformation. It becomes visible, that the chosen pass-schedule leads to a strong adiabatic heating in the core of the workpiece resulting in a temperature increase to 1,145°C. Thus, the maximum acceptable deformation temperature of 1,130°C has been exceeded resulting in a high risk of critical grain growth and inferior mechanical properties.

As a result, the pass schedule is slightly adapted in the forging technology suite ComForge® (**table 2**). To decrease the adiabatic heating, the elongation per pass is slightly reduced to an average value of 1.25 per pass. Since a reduced elongation would lead to an increased process time, the average manipulator feed is increase to 60 mm per pass to achieve an identical process time considering the same machine parameters.

Again, the temperature is analyzed using ComForge® Property Predictor as shown in **figure 5** (right), where the maximum temperature now can be kept below the critical value, considerably reducing the risk of critical grain growth. Overall, this example shows how ComForge® Property Predictor can contribute to the technology-related process design in radial forging.

Use case: process profitability

Besides the workpiece quality, the combined usage of ComForge® Pass Schedule Calculator and ComForge® Property Pre-

dictor can also offer a benefit directly linked to the process profitability in radial forging. While for highly valuable material grades as Titanium or Ni-Base the optimization of the workpiece quality can be regarded as most decisive aspect, for a wide range of material grades the process efficiency represents the most important performance indicator. Regarding pass scheduling, the profitability can be influenced mainly by two aspects:

- forging time – determines possible output,
- required forging temperature – determines heating costs.

Together with ComForge® Pass Schedule Calculator, ComForge® Property Predictor allows for the detailed analysis and design of pass-schedules with regard to these process specific parameters. For a forging process of AISI 304 using an SMX with a force of 18 MN, the process is analyzed. It is well known, that the applicable temperature range for forging of AISI 304 is 880°C to 1,250°C. Based on these input parameters, the process sequence is calculated.

When analyzing the pass schedule using ComForge® Property Predictor, it can be found that after the sixth pass the surface temperature is still 975°C, whereas the temperature 25% below the surface is even more than 1,050°C. This clearly shows that the permissible temperature window can be adhered to without any problems and that the furnace temperature can be lowered.

Hence, in the next step the furnace temperature is reduced to 1,080°C. While the pass schedule remains unchanged, the process time slightly increases to 378 seconds since higher forces are required. Analysis with ComForge® Property Predictor shows the following results (considering identical machine parameters):

Table 2. Pass schedule #2 (process time without planishing: 330 seconds)

Pass No.	d ₁	Feed	Elong.	Turning angel
1	410mm	38mm	1.20	30°
2	369mm	41mm	1.23	30°
3	329mm	48mm	1.26	30°
4	290mm	58mm	1.29	30°
5	256mm	76mm	1.28	30°
6	226mm	80mm	1.28	30°
7	200mm	80mm	1.28	30°
8 (Planishing)	200mm	20mm	1.00	11°
Average without planishing:		60mm	1.25	

- › surface temperature: 890°C
- › temperature 25% below surface: 960°C

So in spite of the reduced initial temperature, the required temperature range can still be achieved. Hence, a reduction of initial temperature as thus saving of heating costs can be realized. This basic example illustrates that the combined use of pass schedule calculation and technology models can be used to increase economic efficiency.

Transferring this example to a radial forging machine with an annual capacity of 20,000 t per year, energy cost saving of approximately 50,000 € per year are possible, depending on local cost factors. Furthermore, assuming an annual production of 10,000 forged pieces, the CO₂-emissions can be reduced by 130 t to achieve a better level of sustainable production.

Summary and Outlook

There hereby presented paper introduces the newly developed process model ComForge® Property Predictor which is part of the developed forging technology suite ComForge®. ComForge® Property Predictor is capable of simulating the temperature and strain distribution in radial forging within seconds for any give pass-schedule. For the first time, at shop floor level a process design based on the material state of the ingot becomes possible. Together with the pass schedule calculation, the process sequence can be optimized with regard to the final workpiece properties, e.g. to analyze critical process conditions such as adiabatic heating of the core for Ni-base alloys. Beside an optimized workpiece quality the advanced technology software

ComForge® Property Predictor ensures significant economic and ecological benefits for the plant operator.

In the next step, the forging technology suite ComForge® will be further developed by coupling ComForge® Property Predictor to the microstructure calculation by SMS group to enable direct calculation and optimization of the resulting microstructure in radial forging. This will be available in the forging technology suite ComForge® under the name ComForge® Property Optimizer. Furthermore, coupling the models to the control system of radial forging machine will allow for an online analysis of temperature, strain and microstructure in radial forging.

■ SMS group

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HIGH EFFICIENCY AND ULTRA-LOW-EMISSIONS

Advanced burner technology for thyssenkrupp's hot-dip galvanizing plant

thyssenkrupp Steel recently inaugurated its newest continuous galvanizing line 10 (FBA 10) in Dortmund, Germany. The plant sets a global benchmark in energy efficiency and low-emission heating.

By using modern regenerative burners from WS Wärmeprozessestechnik GmbH in double-P radiant tubes, the new continuous galvanizing line at thyssenkrupp Steel typically saves between 15% and 30% fuel as compared with conventionally heated furnaces. At the same time, particularly low NO_x emission values are achieved, thanks to the patented FLOX® combustion process. Due to its high efficiency and the excellent temperature uniformity of the radiant tubes used, the heating system also creates a perfect basis for a later switch to green fuels such as hydrogen.

With a total of three vertical strip-processing lines, the thyssenkrupp plant in Dortmund is one of the world's most modern locations for the annealing and surface finishing of steel strip. Together, the three lines can process up to 2,000,000 metric tons of steel per year.

WS already delivered nearly 800 modern gas burners to the Dortmund location,

making it one of the most advanced and environmentally friendly sites worldwide. Regarding the regenerative burners used for FBA10, Dr. Clemens Trachternach, team leader of FBA 10, says: "It is the best technology available on the market, which we are installing in order to really future-

proof the plant and still safely undercut the emission limits many, many years from now."

Crucial to meeting this goal is the decades of experience at WS with the multiple award-winning and patented FLOX® technology, which is already successfully in use in tens of thousands of burners worldwide. The FLOX® combustion technology allows highly efficient burners to be operated with particularly low NO_x emission levels. "It is our ambition at WS, to provide solutions for all continuously operated strip lines which can reliably attain NO_x emissions well below 100 mg/Nm³, with simultaneously high combustion efficiency over 80% and which are, already today, suited for a future with green combustion gases" says Dr.-Ing. Wüning, President of WS Wärmeprozessestechnik GmbH.



REGEMAT® 250 in Double-P-Tube (Picture: WS Wärmeprozessestechnik GmbH)

WS Wärmeprozessestechnik GmbH

Dortmund: competence center for hot-dip galvanizing and surface technologies

The new hot-dip galvanizing line at thyssenkrupp Steel's Dortmund location, FBA 10, was inaugurated in October 2022. Since, the FBA 10 line has gone into technical ramp up. With now two modern strip processing lines, Dortmund will become the European center for high-quality hot-dip galvanized steel strip products.

At the new line, thyssenkrupp Steel can produce top-quality surfaces for vehicles, for example, and also offer the highly innovative zinc-magnesium products, which thanks to their low application thickness save both materials and costs, as well as being sustainable. Overall, thyssenkrupp has further strengthened its portfolio of stronger and thinner premium steels with the new plant.

With the investment of over a quarter of a billion euros, Dortmund is consolidating its position as a center for high-quality surface technologies. Together with FBA 8, which is in operation just a few meters away from and adjacent to the new FBA 10, around one million metric tons of hot-dip galvanized products will roll off the two state-of-the-art lines in the future. The FBA 10 line will produce around 600,000 metric tons of hot-dip galvanized steel per year. A wide range of grades will be produced in almost all strength classes for outer panels and structural components, as well as selected industrial products.

thyssenkrupp Steel Europe

TRANSPARENCY IS THE KEY

Access to all data on order and production

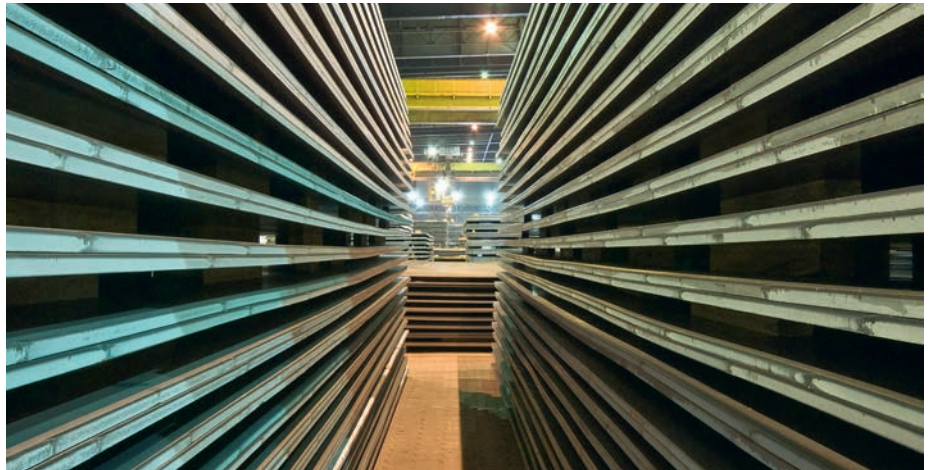
The “myE-service” tool from heavy-plate manufacturer Dillinger combines complex data that can be accessed online at any time with customisability according to needs

Dillinger, one of Europe’s leading producers of heavy plate, is committed to a corporate culture of innovation in all areas. The driving force here is the company’s innovation management along the entire value chain. A prime example of this is the range of digital services provided within its web-based customer portal – a feature developed on the basis of close cooperation with the customer. Now the renowned steel-maker opens up for its customers a transparency of order- and production-related data previously unattained on this market with the first expansion stage of its E-Service platform. Under the programmatic name “myE-Service” it combines the high complexity of data retrievable online at any time with practically unlimited filter options and needs-orientated customizability.

Pilot customers have again been closely involved in the drafting of this new module for Dillinger’s online service portal. The myE-Service program has been developed inter alia on the guiding principle of providing greater planning certainty for customers. As in the past, users will find in the system all order-related data, such as certificates, confirmation of order, invoices and shipping advice. But now they can also view the latest status of production of ongoing orders around the clock – selected from three different information levels: project – order – item. The individually configurable degree of detail of these levels enables to draft a tailor-made status report in a short time.

Detailed up-to-date information at the required depth

Existing users of the previous E-Service system reach a dashboard displaying various brief summaries via their familiar log-in-data, new users via a once-only registration procedure. These summaries indicate at a glance, for example, the key information on projects, such as the number of plates still to be delivered or the deliveries completed since the last log-in. A simple click enables customers to progress from this introduction page to



Users are provided with summaries indicating at a glance, for example, the number of plates still to be delivered (Picture: Dillinger)

one of three different viewing levels. Here they find the so-called “mega-tables” containing comprehensive data on their various projects and orders, up to and including all individual items. The important information displayed here features, among other things, the scheduled week of shipment and the number of plates ordered, rolled and delivered. In addition, at the customer’s request, other production and shipment details can be displayed. The information shown is updated twice each day.

Individual configuration of needs-orientated reports

This data can be individually filtered at all three levels in the same way as conventional excel files, in order to permit drafting of a needs-orientated report: columns can be merged in or out, repositioned, and/or their width modified. This feature is especially advantageous where there are multiple users from a single customer – the Purchasing and the Technology departments, for example: every viewer can configure, store and continue to use – for further reports – individual views in accordance with his or her particular evaluation focuses. This far-reaching customisation potential also

gives the new system its name: myE-Service. The individually compilable reports can be exported as CSV or PDF files at any time. In addition, standardised status reports can also be stored in either – or both – of these file formats.

Direct access gives the customer greater planning certainty

The activation of this new service tool is Dillinger’s response to customers’ requests for increasingly greater planning certainty. Thanks to its clear differentiation and up-to-date status, the data provided makes customer communication significantly faster, and thus even more efficient. In addition, the clarity of the system at any desired degree of detail and its needs-orientated customizability facilitate spot-on information handling. The overwhelmingly positive customer response to myE-Service yet again confirms Dillinger of the correctness of its road to digitalisation of the value chain: in an increasingly complex and volatile world, transparency is more than ever trumps in the successful joint mastering of the challenges of the future.

| Dillinger

DIGITAL RESOURCE MANAGEMENT

Keeping an eye on all assets

The industry platform “Steelsuite” enables companies to easily enter into digital resource management. The “Asset Manager” module displays the operating status of machinery, equipment and other operating resources.



“Asset Manager” generates diagrams that inform about the operating status of machines, equipment and other resources (Picture: Kaltenbach.Solutions)

The industry platform “Steelsuite” from Kaltenbach.Solutions GmbH enables medium-sized companies and corporate groups to enter into digital resource management with manageable effort. The proven solution for the steel trade, steel construction and mechanical engineering companies consists of several modules. The “Asset Manager” element displays the operating status of machinery, equipment and other operating resources in the form of simple graphics. Malfunctions and maintenance or service deadlines are visible at a glance. As a result, the availability of operating resources increases and maintenance costs can be reduced.

Industrial companies have a large number of very different operating assets such as machines, crane systems, vehicles, PCs, distributors of data streams, routers or mobile terminals. Efficient asset man-

agement has a major impact on production costs, maintenance processes and the availability of machines. Digitally supported solutions are useful for obtaining an overview of all operating equipment. Kaltenbach.Solutions has developed the “Asset Manager” module as part of its comprehensive “Steelsuite” solution for the steel industry and mechanical engineering. Where shift supervisors used to have to collect information on the condition of operating equipment, today all that is needed is a glance at the display of a smart phone or computer.

Various menu items can be used to control the processes related to maintenance and care as well as UVV inspections of systems, machines and individual devices. This also makes it possible to see where problems exist. The “Shutdown & Malfunction” view shows the appropriate process solutions for rectification. The digital

“Logbook” records all events to give users an overview of previous activities at any time. It also makes it possible to structure the management of operating resources in a meaningful way. Several medium-sized companies and groups in the steel industry in Europe are already using the industry solution for clear working capital management and are also benefiting from the significant savings potential.

■ *Kaltenbach.Solutions*

TIME SAVINGS AND A REDUCTION OF ERROR RATES

thyssenkrupp Materials Processing Europe rolls out data exchange via mpe edi deluxe

The German service center specialist has optimized the exchange of data with its customers via edi and added several new functions



Fast and compact information exchange is essential for the smooth running of business processes (Picture: thyssenkrupp)

Time savings and the reduction of error rates in production workflows as well as business processes: Aspects that are becoming increasingly important for customers in the dynamically changing environment. Fast and compact information exchange is essential for the smooth running of business processes and also saves resources elsewhere.

With mpe edi deluxe, customers have the option of having the inspection data of their material and paper or PDF certificates transferred and stored in their individual ERP system – and this completely automatically. “We are thus able to simplify data exchange between suppliers and customers. The elimination of manual steps also minimizes the error rate,” says Sandro Freudenberg, Sales Manager at the Stuttgart site of thyssenkrupp Materials Processing Europe. Due to the automated processes, there is a high time saving and personnel resources can be

used more effectively. Customers also benefit from minimizing the cost of a complaint, as information about the manufacture of the



“We can simplify data exchange between suppliers and customers.”

Sandro Freudenberg, Sales Manager at thyssenkrupp Materials Processing Europe



products is stored in the system. As a result, the customer’s inventory can be better selected and sorted. In addition, there are further development possibilities up to the introduction of inspection mechanisms such as a target/actual comparison of material properties.

Sustainability as an essential component of all business activities

Sustainable action is an essential factor in all activities of thyssenkrupp Materials Processing Europe. As part of its sustainability strategy, the parent company thyssenkrupp Materials Services has set itself the goal of operating on a climate-neutral basis by 2030. In addition, the company also wants to accompany its customers on this path and offers green products and solutions to reduce CO₂ emissions in the supply chains.

Offers such as mpe edi deluxe are an important part of this. In addition to steadily increasing digitization, thyssenkrupp Materials Processing Europe is also contributing to environmental protection with other projects: These include the offer of a pallet return system and the use of robust plastic pallets for recycling to enable more careful use of the scarce raw material wood. In addition, customers can take advantage of recycling services as part of their scrap disposal. In

this way, surplus materials are bundled for remelting and fed back into the recyclable materials cycle in a structured manner.

| thyssenkrupp Materials Services

THE AMERICAS – BRAZIL

Petrobras signs supply agreement for OCTG tubing

As part of a strategic alliance with Tenaris, Alleima will supply oil country tubular goods (OCTG) under a new long-term supply agreement between Tenaris and Petrobras.

The agreement includes the three-year supply for offshore Brazil, where pipes will be used in various exploration and pro-

duction wells in the pre-salt fields. It entails the provision of corrosion-resistant pipes produced by Alleima and finished with TenarisHydril Blue® premium connections and Dopeless® technology. The products will be manufactured by Alleima in Sandviken, Sweden, and threaded at the Tenaris threading facility in Aberdeen, Scotland.

Alleima and Tenaris have had a strategic partnership since 2003, aimed at adding value to the oil and gas industry through joint research, product development, and the manufacture of specialized tubular solutions for demanding applications.

Alleima

THE AMERICAS – USA

Mill Steel Co. expands into stainless steel and aluminium markets

Mill Steel Co., distributors of flat-rolled carbon steel, has acquired Cleveland Metal Exchange (CME) and Chicago Stainless Metal Exchange. With these transactions, Mill Steel Co. is expanding into the flat-rolled stainless steel and aluminium metal markets.

A full line of stainless steel and aluminium products is now available through the Mill Steel Stainless and Aluminum division led by former CME CEO Randy Horvat and President Jeff Haas. Mill Steel plans to leverage its vast processing footprint and dedicated carrier network along with CME's extensive supply chain to bring competitively priced aluminium and stain-

less products to market. The company will immediately assume steel processing and supply for CME's broad array of manufacturing, automotive, and construction industry customers in the Southeastern, Mid-South and Western United States.

Mill Steel Co.

SSAB Americas releases EPD results

SSAB Americas has released its Environmental Product Declarations (EPD) results of its commercial steel and advanced high strength steel (AHSS) product lines in the U.S.

Results show SSAB Americas EPDs are industry-leading in lower environmental impacts when compared to the American Iron and Steel Institute (AISI) steel indus-

try data and the Buy Clean California Act (BCCA) threshold limits. An EPD is an independently verified document that provides transparent, comparable information about the environmental impact of products from the lifecycle perspective.

As part of SSAB Americas' on-going commitment to create a stronger, lighter and more sustainable world, the certified EPD results demonstrate the long-term

beneficial focus of SSAB Americas environmental sustainability. It also provides a response to requests from customers, suppliers and the political and investment communities about the environmental impact of steel produced by SSAB Americas.

SSAB Americas



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PROFILE MIT CHARAKTER

Wir wandeln Edelstahl, Nickellegierungen oder Titan in hochwertige Profile. Warm-gewalzt oder kaltgezogen. Unsere Standard- und Sonderprofile werden in nahezu allen Wirtschaftszweigen geschätzt und eingesetzt. Weltweit. Wegen ihrer Qualität, basierend auf Wissen aus fünf Generationen.



BOLLINGHAUS
STEEL



THE AMERICAS – USA

Nucor to expand its Towers & Structures business

Nucor Corporation will build two new state-of-the-art tower production plants as it expands its recently established Nucor Towers & Structures business unit.

In 2022, Nucor formed the Nucor Towers & Structures business unit when it acquired Summit Utility Structures LLC, a producer of metal poles and steel structures for utility infrastructure in eastern

Pennsylvania. While that location primarily serves customers in the northeastern part of the country, Nucor will establish a nationwide footprint with the new facilities. The growing demand for utility infrastructure is being driven by grid hardening and replacements, renewable energy projects and population growth.

The two new greenfield transmission tower production plants will be extensively automated and include advanced hot-dip

galvanizing operations. Each facility will utilize highly efficient straight-line production and will increase Nucor Towers & Structures' capabilities to provide engineered solutions for utility infrastructure and construction projects. Nucor is evaluating locations in the Midwest and the Southeast.

■ Nucor

Nucor introduces sustainable steel product for offshore wind energy applications

Nucor has introduced Elcyon™, a new sustainable heavy gauge steel plate product made specifically to meet the growing demands of America's offshore wind energy producers.

Nucor will manufacture Elcyon at the company's new state-of-the-art Nucor Brandenburg steel mill in Kentucky, which produced its first steel plate at the end of

December 2022. Elcyon is a clean, advanced steel product made using Nucor's recycled scrap-based electric arc furnace manufacturing process. Nucor's circular steelmaking route has a greenhouse gas emissions intensity that is one fifth the global blast furnace extractive steelmaking average, based on Scope 1 and 2 emissions. Utilizing thermo-mechanical controlled processing at the new mill,

Elcyon was created specifically to meet the rigorous quality standards of offshore wind energy designers, manufacturers and fabricators. Along with meeting Euronorm specs, Elcyon is characterized by larger plate dimensions, improved weldability and excellent fracture toughness, as compared to competing products.

■ Nucor

EUROPE

SSAB and Stena Stål partner on fossil-free steel supply

SSAB has entered into an agreement with steel distributor Stena Stål under which Stena Stål will be the first external distributor to supply fossil-free steel to the Swedish market, starting in 2026.

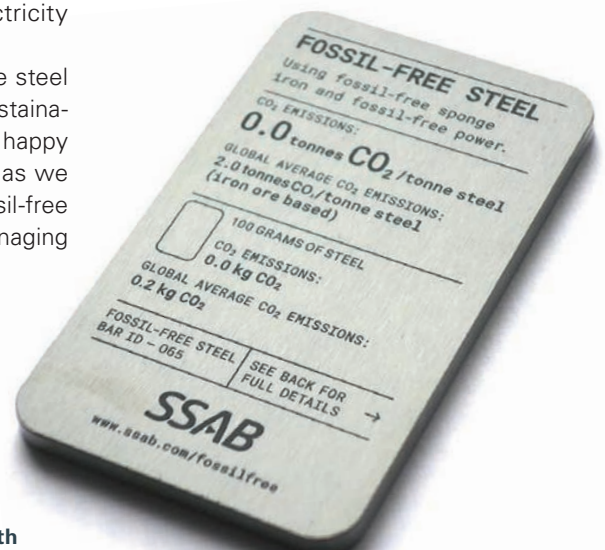
The letter of intent signed by Stena Stål and SSAB adds another link to the value chain of a future fossil-free steel market. SSAB plans to deliver fossil-free steel to the market at a commercial scale by 2026 and largely eliminate carbon dioxide emissions from its operations by around 2030. SSAB works 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.

"For us at Stena Stål, fossil-free steel is central to our journey towards sustainable steel distribution. We are very happy about this partnership with SSAB as we take important steps towards a fossil-free future," says Stefan Svensson, Managing Director at Stena Stål.

■ SSAB

SSAB aims to supply the market with fossil-free steel at a commercial scale by 2026
(Photo: SSAB)



EUROPE

ArcelorMittal and Gonvarri Industries sign sustainability MoU

ArcelorMittal Europe - Flat Products and Gonvarri Industries have signed a Memorandum of Understanding to cooperate more closely on reducing CO₂ emissions and strengthening both companies' sustainability performance in the automotive market.

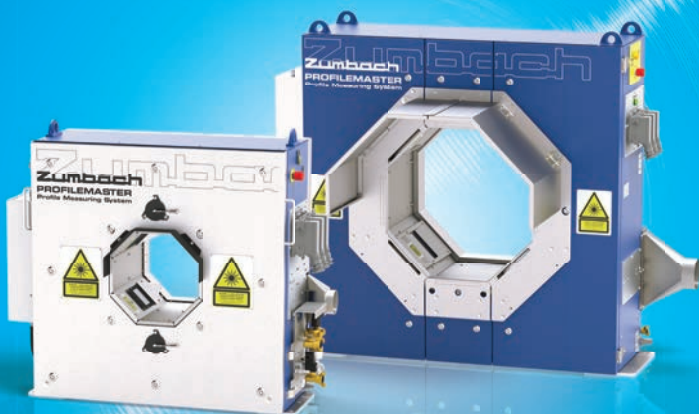
The MoU was signed by Gonvarri Industries Executive Chairman Jon Riberas and ArcelorMittal Europe - Flat Products CEO Yves Koeberle focuses on the two companies working on common sustainability projects, including the use of ArcelorMittal's XCarb reduced and low-carbon products, as well as identifying ways to strengthen the circular economy both within and beyond the manufacturing and purchase of steel products.

In 2020, flat steel processing company Gonvarri Industries committed to reducing



Jon Riberas (left) and Yves Koeberle after signing the MoU (Photo: ArcelorMittal)

Zumbach
SWISS PRIME MEASURING SINCE 1957



4 - 8

Number of cameras



5

Min. object diameter (mm)



720

Max. object diameter (mm)

PROFILEMASTER® SPS Profile Measuring System

The PROFILEMASTER® SPS is a light section measuring device for measuring contours and dimensions on profiles of all kinds in cold and hot steel applications.

Benefits:

- ✓ Maximum measuring accuracy thanks to temperature-stabilized measuring systems
- ✓ Shape fault detection (SFD) thanks to high sampling rate
- ✓ High-precision measurements
- ✓ Detects process problems at an early stage
- ✓ Fast maintenance and easy cleaning



its Scope 1 emissions by 50% by 2030, as well as operating solely using renewable electricity, as part of a commitment to reducing Scope 2 emissions by 100% by 2030. The company has further committed to carbon neutrality by 2050. Working with suppliers such as ArcelorMittal is part of the company's strategy to accelerate the reduction in CO₂ emissions, specifical-

ly Scope 3 emissions (indirect CO₂ emissions produced in the company's supply chain).

ArcelorMittal Europe has a target to reduce its CO₂ emissions by 35% by 2030, and to reach carbon neutrality by 2050. In 2021, the company launched XCarb®, an umbrella brand for all its low and zero-carbon initiatives. This includes

XCarb® green steel certificates, which can be purchased by customers to reduce their Scope 3 GHG emissions, and XCarb® recycled and renewably produced steel made using a very high proportion of steel scrap and 100% renewable electricity.

■ *ArcelorMittal*

EUROPE

Ruukki Construction to acquire Poimukate

Ruukki Construction, a subsidiary of SSAB group, has signed an agreement to acquire roof and wall profile manufacturer Poimukate Oy.

Poimukate manufactures steel roofing and roofing accessories as well as façade clad-

ding. The company will continue to operate under its own brand with the current management and staff. The acquisition supports Ruukki's complete roof solutions strategy and strengthens the company's service and product offering. Ruukki Construction provides sustainable steel-based

building products and services for walls and roofs.

■ *Ruukki Construction*

JAPAN

Akita Noshiro offshore wind farm project uses steel from Dillinger

Approximately 26,300 t of heavy plate were supplied for the monopile foundation structures of the Akita Noshiro offshore wind farm project.

The Akita Noshiro project, the first large-scale offshore wind power farm in Japan, recently began operation. For the monopile foundation structures, Dillinger supplied more than 26,000 t of heavy plate in thicknesses ranging from 50 to 100 mm.

The offshore project, which includes the Akita and Noshiro wind farms, is part of Japan's ambitious green energy development plan. With 33 wind turbines and an annual capacity of 139 MW, the wind farms will soon be supplying around 124,000 households with environmentally friendly electricity. The wind turbines are mounted on monopiles that are over 78 m long and weigh around 880 t. The monopiles are installed in 10 to 30 m deep water.

■ *Stahl-Holding-Saar*



Unloading of the first monopiles for Akita Noshiro (Photo: Sif-Group)

STEEL FOR RENEWABLE POWER GENERATION

Millions of tonnes of steel needed to power the future Britain

The steel sector is crucial to decarbonising the UK's energy supply and reducing dependence on foreign imports. The UK will need more than 10 million tonnes of steel in the coming years to become energy self-sufficient.

The UK Government set out plans to secure 'clean and affordable' energy in its Energy Security Strategy in 2022. Achieving greater self-sufficiency has become vital after global events led to rocketing energy prices and significant government interventions in the energy market to cap prices.

New research from Tata Steel – the country's largest steel producer – reveals more than 5 million tonnes of steel will be needed to build thousands of wind turbines at sea by 2030. Planned solar and nuclear power plants which would power future Britain are expected to require about 3.5 million tonnes of steel over the coming years.

wind structures. A strong domestic and secure steel industry is also fundamental to delivering the UK Government's ambitious energy plans. But if British manufacturers are to supply the essential steel and continue to employ many thousands of people in this country, we need to invest and transform this strategically important industry so it can make carbon-neutral steel. We need to learn the lessons from the UK's energy supply which, as the Government says,

UK's infrastructure projects, manufacturing industry and national security."

Roy Rickhuss CBE, General Secretary of Community and Chair of the National Trade Union Steel Coordinating Committee, said: "The green energy revolution presents a huge opportunity to build a robust British supply chain based on the supply of top-quality domestic steel. The events of the last two years tell us Britain cannot rely on fragile global supply networks for stra-

"Geo-political events and disruptive trade issues in recent years have reminded us of the importance of being self-sufficient in essential products like steel."

Henrik Adam, Chairman of Tata Steel UK

An estimated 1.5 million tonnes of steel will be needed to build the infrastructure for hydrogen production and distribution as well as large-scale carbon capture (CCS) projects. And the metal will also be needed to unlock new sources of oil and gas from the North Sea.

Henrik Adam, Chairman of Tata Steel UK, said: "Recent events have shown us just how crucial it is to have a secure energy supply. Achieving this will need an energy revolution in this country requiring millions of tonnes of steel to build new energy generation projects. UK steelmakers, like Tata Steel, want to be part of this revolution, such as by developing new steel products for solar farms or for floating offshore



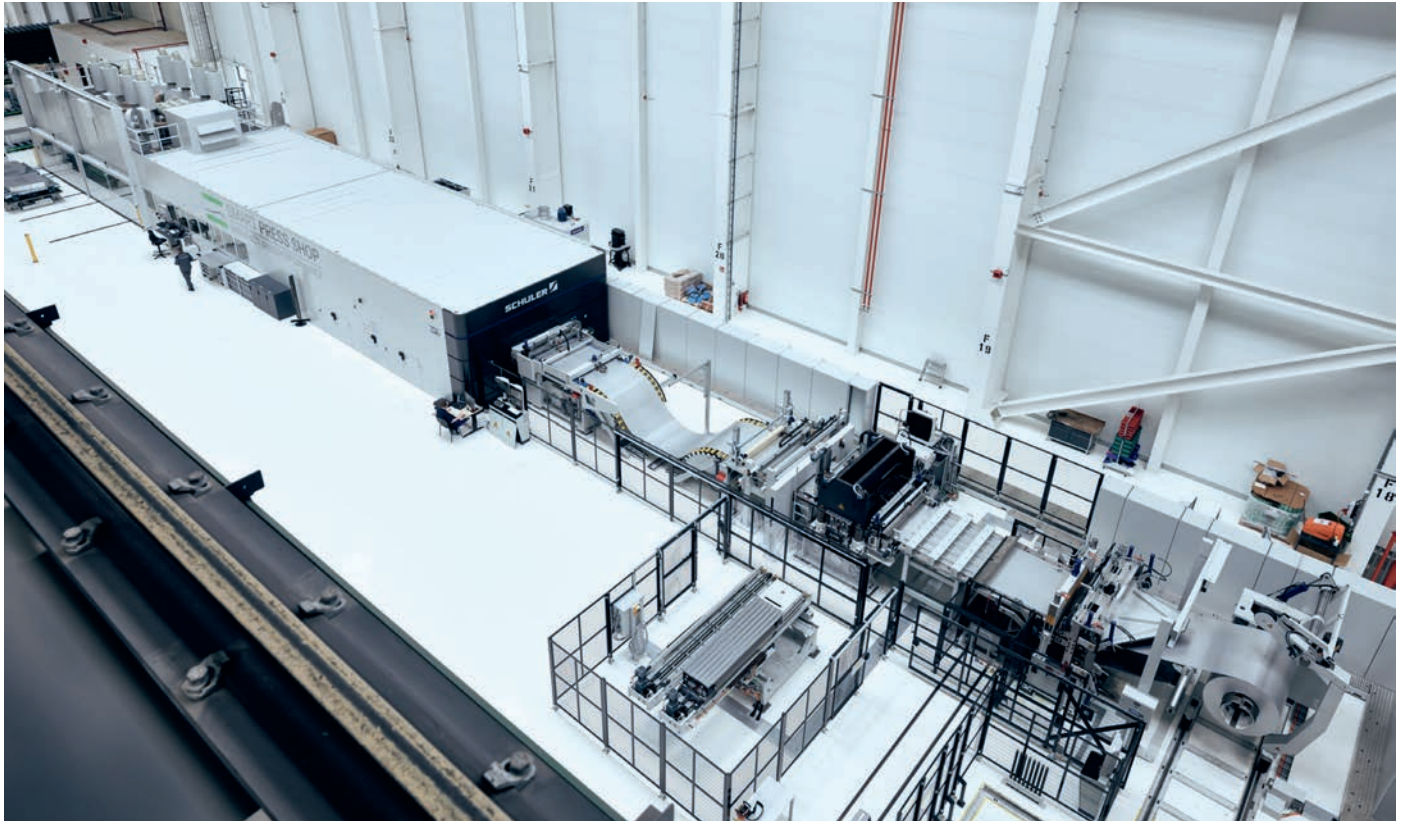
Henrik Adam, Chairman of Tata Steel UK (Picture: Tata Steel)

'drifted into dependence on foreign sources', undermining the country's energy independence. Similarly, our steel industry is at a crossroads – if we do nothing, we risk it declining and drifting away to other countries. Down the other path is a new era in which we transform the steel production process to make it fit for the 21st Century."

Henrik Adam added: "Geo-political events and disruptive trade issues in recent years have reminded us of the importance of being self-sufficient in essential products like steel, a product critical for the

tegic goods, and if we want to go green it is nonsensical to transport steels from the other side of the world. Not only will using Britain's steel be crucial to meeting our climate objectives, it will support thousands of good jobs and steel communities across the country. Steelworkers look to the government to support investment in green steel and do more to ensure that British jobs benefit from taxpayer-backed energy projects."

Tata Steel UK



The laser blanking line at Smart Press Shop in Halle/Saale with the Amepa systems installed behind the leveler
(Picture: Schuler Pressen GmbH)

PARAMETERS WITH DECISIVE INFLUENCE ON PRESS FORMING

Inline measurement of roughness and oil film thickness at Smart Press Shop

Two inline systems have been commissioned for surface roughness (AMEPA SRM) and oil film measuring (AMEPA OFM) at Smart Press Shop of Porsche and Schuler. Integrated into track and trace, the new systems help to increase the rate of good products and to reduce waste.

Smart Press Shop, a joint venture company established by Porsche and Schuler in the German city of Halle on the river Saale, produces high-quality body shell parts for the automotive industry. With this innovative press shop and its many advanced features, the two JV partners have raised press forming to a new technological lev-

el and created a new benchmark for the future of metal forming.

Track & trace makes the product smart

An integral element of production control and quality assurance at the facility is the Schuler track & trace system. It interlinks

each individual product with the relevant material and production data and tracks every meter of strip downcoiled and fed into the laser blanking line along the entire production chain up to the point where it leaves the press line as a shaped component.

Each blank is laser-marked on the fly with a specific ID code that makes it pos-

Andreas Gebele, Schuler Pressen GmbH, Göppingen, Germany; Wolfgang Bilstein, Ansgar Berlekamp, Amepa GmbH, Würselen, Germany – Contact: ansgar.berlekamp@amepa.de

sible to identify the blank as it passes through the various production stages. All relevant product information is stored in a data base. Thus, it can be checked at any time what coil each individual product originates from and what material properties it possesses.

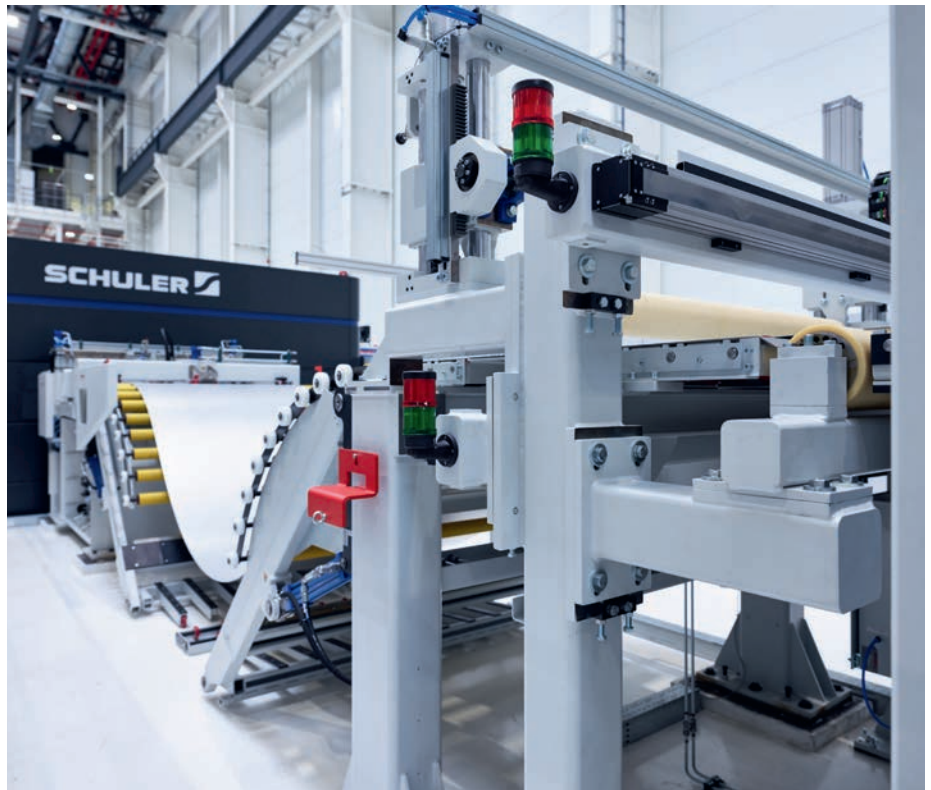
The track & trace system has direct access to the data in the process control system. This ensures that only first-hand information is stored. The thus achieved high process transparency makes it possible to forecast production issues. Therefore, the track & trace system plays an important role in minimizing waste and guaranteeing high quality of the products.

“Trial and error” has become a thing of the past

The surface roughness and oiling condition of incoming coils are two quality-critical parameters in a press shop. They determine the friction acting between the blank and the deep-drawing die – e.g., the flow behaviour of the blank material when it is pressed around the edges of the forming die. The aim of the “surface roughness and oil film measurement” project was to make it possible for a press shop operator to instantly react and make adjustments to the process in case a coil with features other than expected is entering the line. This was to be achieved by relating the specific roughness and oil film data to the respective blanks so that it would be possible to predict how each one of the blanks will behave during downstream press forming. This knowledge would form a solid basis for optimizing the pressing process, if necessary, e.g. by adjusting the oil dispensing unit at the press line entry. In the event that oiling issues, such as dry stripes, have been identified at the blanking line entry, this could be corrected by re-oiling the strip before it enters the press line. Therefore, an inline measurement system able to provide reliable inline data about the strip thickness, surface roughness and oil film condition was to be installed at the blanking line entry.

Based on the data provided by this system, the parameters of the press can now be optimally set to ensure that only “OK parts” are produced.

So far, line adjustments to account for variations in surface roughness and oil film condition used to be a matter of “trial and error” and depended, to a large degree, on



Mounted on motorized traversing beams, the sensors can move across the entire strip width (Picture: Schuler Pressen GmbH)

the press operator’s individual skills. Thanks to the track & trace system, data science can now be used to make decision-making more precise and achieve higher accuracy of repetition. This avoids out-of-spec production and is a significant cost-saving factor. Moreover, the reduced scrap rate has a direct positive impact on the press shop’s carbon footprint.

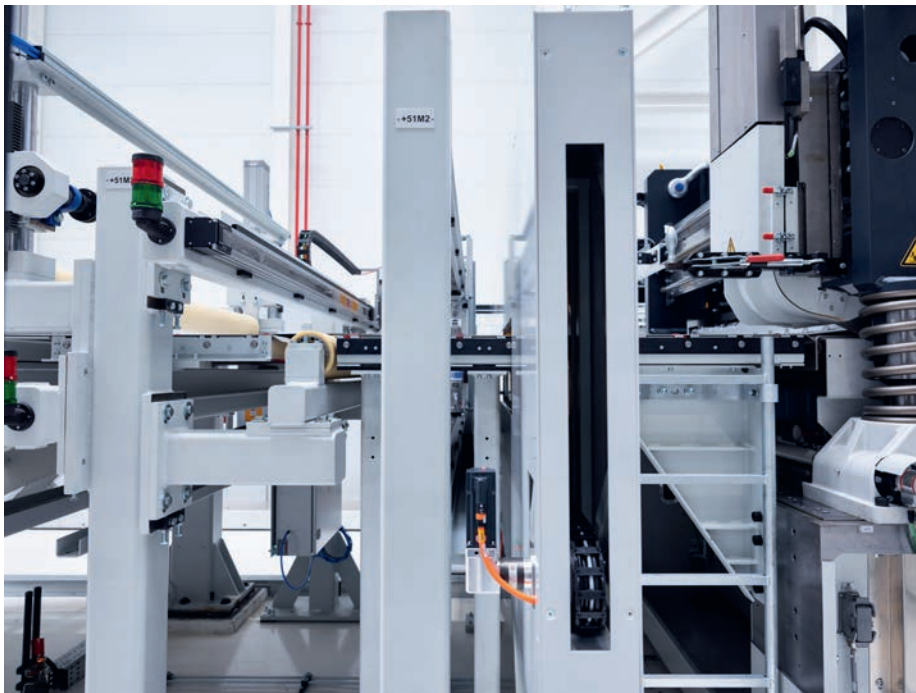
Two parameters within one unit

Schuler and Amepa can look back on many years of cooperation and many successful joint projects. One area of cooperation is preparing blanking lines ordered by customers wishing to install the measuring equipment at a later stage for the subsequent integration of measuring systems.

For the surface roughness and oil film measurements, Amepa proposed a combined tribological system of a worldwide unique layout, suitable to measure both steel and aluminium. Several factors were decisive for Schuler to decide in favour of the Amepa system. Excellent measuring accuracy in both measuring modes was of course one of them. In addition to this, Schuler was looking for a company that

would be able to supply both systems within a harmonized solution and have the necessary expertise to implement the electrical and data interfaces according to the specifications formulated by Schuler to ensure smooth integration into the new line. In November 2020, the JV awarded Schuler the order for the supply of the new system.

The inline strip roughness measurement unit SRM 100 uses the laser light section method, a two-dimensional laser triangulation technique patented by CRM Centre de Recherches Métallurgiques, Liege, Belgium, for inline roughness measurements. The technique was scaled up for industrial use by Amepa GmbH. 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. Various measurements can be combined to make the method DIN EN ISO 10049-compliant. The roughness sensor measures transversely to the rolling direction. This is of relevance particularly when measuring the roughness of aluminium strip. In addition to the Ra val-



Due to their compact design, the measuring systems require very little installation space in the line (Picture: Schuler Pressen GmbH)

ue, other statistical values, including RPC and Rz can be calculated.

Traditionally, oil films on metal strip surfaces are measured by gravimetric offline analyses in a laboratory. However, these offline measurements of just a few random samples are not suitable to give a true picture of the layer thickness and the distribution of the lubricants on the entire surface of a coil or blank. As a result, oiling issues are often recognized too late or remain undetected.

In contrast, the Amepa OFM system operates inline, by measuring the reflection and absorption of an infrared light beam projected onto the strip surface. The system calculates the oil film thickness in g/m² by comparing the measured values with calibration data previously determined with high-precision balances in a laboratory. Calibration measurements are made of the materials processed – e.g., steel or aluminium, different textures and types of dry and fluid lubricants.

The project

One and a half meters of space in the strip run direction was available behind the leveler of the blanking line for the new measuring system – sufficient for the Amepa solution thanks to the fact that the roughness sensor is of a particularly compact design. The sensing units of both systems can travel and capture data across the entire strip width.

The systems (SRM and OFM) were installed in August 2021 and commissioned in October 2021. As they were running without a hitch, Schuler issued the FAC as early as in November 2021.

All data from the strip measurements are sent via a data interface to the track & trace system that interlinks them with the respective blank data. An interpolation algorithm developed by Schuler makes it possible to generate a complete, gapless measuring profile. The measuring systems installed are fully integrated into the control and visualization environment of the line. This makes operation very user friendly: The line operators have all measurement and control data available at a glance.

Information instantly available

For every coil in the line, the track & trace system sends material and lubricant data via an interface to the Amepa systems. The systems then retrieve the respective calibration data from the database and compare them with the measurements.



The measured values are graphically displayed in a clearly structured form by meter of strip (Picture: Schuler Pressen GmbH)



Moving across the entire width of the strip, the sensors measure the oil film (left) and the surface roughness (right)
(Picture: Amepa GmbH)

quality. This avoids scrap and significantly increases the rate of OK parts – two effects from which press operators benefit in terms of massive cost savings and higher profits.

Outlook

The capability of interlinking the measured strip values with each individual blank also supports overall process optimization. If, for example, it turns out that certain combinations of surface roughness, oil film condition and other parameters are unable to achieve the desired quality, processes can be adjusted and fine-tuned with the support of the measuring and track & trace system.

It will even happen that certain combinations of material parameters lead to better results than expected from experience. In this case, it may be an option to try out operating within a larger process window because, due to the enhanced process understanding, it may well be possible to weaken the coil specifications for certain products.

Thanks to the data available from the inline measurements, we also gain unprecedented understanding of where exactly defects and poor product quality originate. This provides us entirely new possibilities to intervene. When a finished component, such as a body shell part, showed defects after welding or painting, it has so far never really been possible to relate that product to the original coil because there was no way to interlink the product with the measurements taken of the coil before processing.

With the track & trace system, all process and material parameters relative to a specific product are readily available and can even be transferred to external downstream processing facilities.

■ *Amepa GmbH /
Schuler Pressen GmbH*

If any of the measured values are not within the allowable tolerance range, the systems immediately trigger a warning. Thus, the operators can instantly take the necessary corrective measures.

If the measurements reveal major quality issues of a coil, that coil can be removed from the line without processing and returned to the coil supplier. Likewise, the system can identify out-of-spec sections of a coil and avoid that these sections are further processed.

However, the most important aspect is the system's capability to influence the forming process. By adjusting the press line parameters based on the measurements taken of the strip, parts that would otherwise have been graded as out-of-spec will leave the press line as OK products. Let's take as an example a poorly oiled strip that would normally have failed in the forming process. By re-oiling, that strip can be turned into a "good" strip and still bring about shaped parts of perfect

INNOVATIVE NEW RANGE OF HIGH STRENGTH AUSTENITIC STAINLESS STEELS

Advanced material solution on the horizon for oil, gas and LNG applications

The N’Genius steel series possesses major improvements compared to 300 Series stainless steels, and a highly economical alternative to various nickel-alloys. Its unique combination of design characteristics, i.e. excellent ductility and toughness at sub-zero and cryogenic temperatures together with exceptionally higher strength and vastly superior corrosion resistance provides key engineering advantages for the onshore and offshore industry.

An innovative range of high strength austenitic stainless steels has been developed by N’Genius Materials Technology, a materials technology company based in Cheshire, England, specialising in the invention of next-generation stainless steels. Patent protected in 30 countries, the N’Genius series is a complete ‘family’ of high strength austenitic stainless steels possessing major improvements compared to 300 Series stainless steels, and a highly economical alternative to various nickel-alloys.

As with conventional austenitic stainless steels, the N’Genius series has excellent ductility and toughness at sub-zero and cryogenic temperatures. But exceptionally higher strength and vastly superior corrosion resistance makes this new family an entirely different proposition.

Engineering advantages for the onshore and offshore industry

Its unique combination of design characteristics provides key engineering advantages for the onshore and offshore industry.

LNG piping systems, engineered products, fabricated products and equipment can be developed and manufactured with reduced wall thicknesses, offering the potential to make products and equip-

and maintenance, repairs, upgrading or replacement work on products and equipment in the future.

In particular, large facilities with extremely heavy topsides including floating production storage offloading (FPSO) ves-

“The potential to optimise the weight and space of components, and in turn reduce costs, could be invaluable. It really is the total system material.”

Dr C.V. Roscoe, the inventor of the N’Genius series

ment lighter and smaller, significantly reducing topside weight and helping facilities overcome space and height restrictions. Any space savings would also improve accessibility regarding servicing

sels, FLNGs and upstream fixed platforms, would greatly benefit from the design and construction advantages that the N’Genius series can provide. This includes the potential to reduce the overall construction

Wrought Mechanical Properties					
Type	Tensile Strength		Yield Strength		PRE _N
	Min		Min		Min
	Ksi	MPa	Ksi	MPa	
304L	70	485	25	170	18
316L	70	485	25	170	24
N’GENIUS™ 304LM4N	109	750	62	430	30
N’GENIUS™ 316LM4N	109	750	62	430	35

Comparison of N’Genius series™ wrought mechanical properties (Table: N’Genius Materials Technology)

time and costs, as well as benefitting from easier handling and lower associated transportation costs.

Dr C.V. Roscoe, the inventor of the N'Genius series, said: "Some of these larger facilities can have topsides weighing more than 50,000 t, which has a major impact on the design and construction cost of oil, gas and LNG projects. The N'Genius series has an infinite range of alloy types, variants and grades and is perfectly suited for all the different material specifications, scopes of work and products including piping systems, pumps, valves, modules, vessels and tanks. Therefore, the potential to optimise the weight and space of all these components, and in turn reduce costs, could be invaluable. It really is the total system material."

Furthermore, the extensive range of alloy types, variants and grades which form the 'family' of grades in the N'Genius series make it suitable for all products, in all service conditions and in the harshest process media environments.

The N'Genius series will also help accelerate the wider implementation of carbon capture and storage (CCS) technology. Inevitably, the addition of onboard CCS for upstream fixed platforms, FLNGs and FPSOs means additional topside weight, volume and space. So a reduction in the weight and size of onboard CCS systems, as could be achieved with N'Genius, would make this green technology become more feasible and play a fundamental role in driving down carbon emissions.

Material characteristics and manufacturing

The key engineering features of the N'Genius series™ of high strength austenitic stainless steels include:

- high mechanical strength with excellent ductility and toughness,
- higher allowable design stresses,
- superior resistance to general corrosion, localised corrosion, erosion corrosion, stress corrosion cracking and

corrosion fatigue relative to conventional austenitic stainless steels,

- excellent toughness at ambient, sub-zero and cryogenic temperatures,
- distinct minimum pitting resistance equivalent values for each alloy type, variant and grade designation.

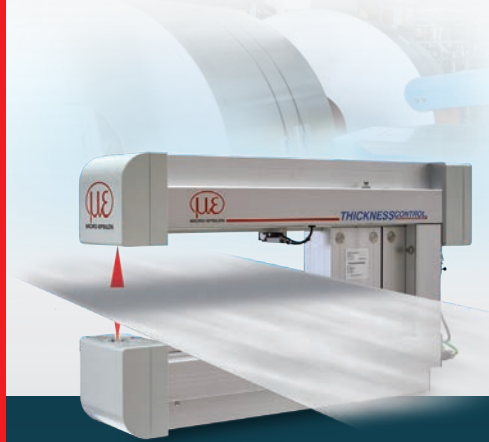
The weight-saving benefits provided by the N'Genius series are achieved from superior wrought mechanical strength properties. For example, the minimum yield and tensile strength of the N'Genius 304LM4N and N'Genius 316LM4N grades are typically 2.5 and 1.5 times higher respectively compared to the minimum strength values of conventional 304L and 316L. This enables the N'Genius series to have significantly higher allowable design stresses than conventional austenitic stainless steels.

Similarly, the higher minimum Pitting Resistance Equivalent (PRE) values for N'Genius 304LM4N and N'Genius 316LM4N grades compared to those for 304L and 316L produce significant improvements in the localised corrosion and general corrosion resistance. This enables products and equipment to last longer, facilities to be designed for a longer service life, and projects made more sustainable and cost-effective.

The N'Genius series can be manufactured in both wrought and cast forms, in an extensive range of products for the oil, gas and LNG industries. These include pipe, tube, fittings, flanges for piping systems, modules, heat exchangers, umbilicals and line pipe for risers, flowlines, pipelines and manifolds. N'Genius technology can also be applied to engineering products including pumps and valves, fabricated products such as vessels and tanks, and specialist products including casing and tubing for Oil Country Tubular Goods (OCTG). The N'Genius series is available to be produced under licence by premier manufacturers of stainless steel products.

■ N'Genius Materials Technology

Philip Roscoe, Paul Harrison, N'Genius Materials Technology Ltd.,
Warrington, Cheshire, England, U.K.
Contact: paul.harrison@nGeniusmaterials.com



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MATERIAL TESTING

Zeleros and ArcelorMittal test the performance of steel for hyperloops

A new, unique ultra-high-speed testing facility has been designed to evaluate the performance of materials needed to build and operate ultra high-speed transport systems of the future

A new, unique ultra-high-speed testing facility has been designed to evaluate the performance of materials needed to build and operate ultra high-speed transport systems. Zeleros, the European company developing the scalable hyperloop, an ultra high-speed transportation system for both public and goods transport, and ArcelorMittal, the world's leading steel and mining company, have carried out trials to analyse the behaviour of steel grades for optimal use in hyperloops.

A testing facility in the form of a spinning wheel that can reach linear speeds of up to 500 km per hour has been designed and built at ArcelorMittal's Rail Excellence Centre in Spain, to test how certain steels perform in ultra-high-speed conditions, prior to testing on a scaled hyperloop track. The results provide data to further advance the selection of the best steels for hyperloop use, considering safety, energy efficiency, cost and scalability as the main decision criteria.

A relevant collaboration for Zeleros' scalable hyperloop

Zeleros and ArcelorMittal have been working together since 2017. Since then, experts from both companies – including all of ArcelorMittal's R&D centres – have jointly developed studies to analyse the way in which materials

behave in high-speed conditions, measuring the effects of key characteristics for hyperloop technology, such as the electromagnetic properties of steels (hyperloop designs propose the use of magnetic levitation). As part of the collaborative work between the two companies, ArcelorMittal's rails business in

"The work we have been doing with Zeleros reflects the importance we place on our involvement in innovative projects using steel in infrastructure and transportation, and that contribute to reducing CO₂ emissions", said Nicoleta Popa, Portfolio Leader of Construction Applications, Infrastructures and Long Products of ArcelorMittal Global R&D.

"The multidisciplinary ArcelorMittal team for the structural, mechanical and electromagnetic aspects, proves the strength of our approach for such complex innovative projects, both in defining new products and in developing new solutions" said Frederic Painchault, Head of marketing of Global automotive & Mobility solutions.

Besides hyperloop, ArcelorMittal has participated in studies of materials for other applications developed by Zeleros, such as the

SELF (Sustainable Electric Freight-forwarder), conceived to move standard intermodal containers in a faster, automated and sustainable way within ports, for which the test track is currently under construction in the port of Sagunto in Spain.

Likewise, the objective of Zeleros is to advance in the construction of mobility solutions that are sustainable and efficient like hyperloop and SELF, accompanied by partners with extensive industrial knowledge, as confirmed by the material studies carried out with ArcelorMittal.

▮ ArcelorMittal/Zeleros



A testing facility in the form of a spinning wheel that can reach linear speeds of up to 500 km per hour (Picture: Zeleros)

Europe – ArcelorMittal Europe - Long Products, Rails and Special Sections – has developed new products with improved guiding and braking performance, as part of the wider co-engineering project between Zeleros and ArcelorMittal.

"To reach Zeleros' vision of building a scalable hyperloop, including the braking, guiding and levitation technology in the vehicle, this collaboration is key. Thanks to the continuous improvement of steels, we can radically reduce infrastructure costs and assure energy efficiency and infrastructure viability", stated Daniel Orient, Zeleros' CTO.

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03 Iron making

03.01 Blast furnaces

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 E-Mail: loi@tenova.com
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03.02 Direct reduction plants

1160 Direct reduction 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

04 Steelmaking

1668 Equipment for steelmaking plants



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DANGO & DIENENTHAL Group
 Hagener Str. 103
 57072 Siegen, Germany
 ☎ +49 271 401-0
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GUILD International
 7273 Division Street
 Bedford, OH 44146, USA
 ☎ +1 440-232-5887
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1670 Engineering and technical assistance



WEEBOTEC GmbH
 Lingenstr. 12-14
 45472 Mülheim an der Ruhr, Germany
 ☎ +49 208 49538-700
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 E-Mail: info@weebotec.de
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1698 Steel mill plants and equipment



WEEBOTEC GmbH
 Lingenstr. 12-14
 45472 Mülheim an der Ruhr, Germany
 ☎ +49 208 49538-700
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 E-Mail: info@weebotec.de
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1699 Steel mill equipment



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

04.04 Electric steel plant

1875 Electric arc ladle furnaces



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

04.07 Secondary metallurgy

2028 Equipment for chemical heating



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

2030 Argon purging equipment

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



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

04.07 Secondary metallurgy

2080 Ladle metallurgical 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

2110 Secondary metallurgical 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

2120 Steel degassing plants



LOI Thermprocess GmbH
 Schifferstraße 80
 47059 Duisburg, Germany
 ☎ +49 203 80398-900
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 E-Mail: loi@tenova.com
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2130 Steel desulfurization plants



LOI Thermprocess GmbH
 Schifferstraße 80
 47059 Duisburg, Germany
 ☎ +49 203 80398-900
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 E-Mail: loi@tenova.com
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2140 T+P lance equipment



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

04.08 Tertiary metallurgy

2144 Vacuum degassing equipment



LOI Thermprocess GmbH
 Schifferstraße 80
 47059 Duisburg, Germany
 ☎ +49 203 80398-900
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04.09 Components

2150 Deslagging machines



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2175 Burning machines for ladles



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



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

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 An der Pönt 59
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2230 Charging machines (trough and tongs)



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 Internet: www.dango-dienenthal.de

2270 Injection plants for argon

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04.09 Components

2440 Handling equipment for oxygen/carbon lances

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 40885 Ratingen, Germany
 ☎ +49 2102 9109-0
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04.09 Components

2490 Coal dust injection lances

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 An der Pönt 59
 40885 Ratingen, Germany
 ☎ +49 2102 9109-0
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2530 Lance robots/-manipulators

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 40885 Ratingen, Germany
 ☎ +49 2102 9109-0
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2580 Oxygen nozzles



LOI Thermprocess GmbH
 Schifferstraße 80
 47059 Duisburg, Germany
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 E-Mail: loi@tenova.com
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04.09 Components

2600 Oxygen lance equipment

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2655 Fuses (multifunction) for burners

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2660 Special safety oxygen hose reels

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 40885 Ratingen, Germany
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04.10 Steel works materials

2735 EBT taphole plugging compound



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

2880 Ladle slide sand

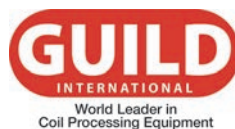


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 ☎ +49 208 49538-700
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07 Hot rolling

07.10 Components

4430 Decoilers and rewinders



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08 Forging, extrusion

08.03 Components

5150 Forging manipulators



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

5155 Forging manipulators, rail-mounted



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 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



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DANGO & DIENENTHAL Group
 Hagener Str. 103
 57072 Siegen, Germany
 ☎ +49 271 401-0
 E-Mail: contact@dango-dienenthal.de
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 Hornstr. 19
 45964 Gladbeck, Germany
 ☎ +49 2043 9738-0
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5180 Transport manipulators



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DANGO & DIENENTHAL Group
 Hagener Str. 103
 57072 Siegen, Germany
 ☎ +49 271 401-0
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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

11.04 Surface treatment plants

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

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

13.04 Finishing lines for tubes

7520 Tube bending machines



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

7544 Tube straightening machines



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

14 Sheet metal processing

14.03 Welding technology

8120 Strip welding machines



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

14.03 Welding technology

8205 Laser welding machines



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

8210 Laser beam welding machines



World Leader in Coil Processing Equipment
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



World Leader in Coil Processing Equipment
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

14.03 Welding technology

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)



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



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

16.02 Forging furnaces

10230 Forging furnaces



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

16.03 Roller Hearth Continuous Furnaces

10260 Roller Hearth Continuous Furnaces



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

10270 Roller hearth and walking beam furnaces



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

16.05 Top-hat furnaces

10310 Top-hat furnaces



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

16.08 Heating furnaces and heat treatment plants

10408 Continuous furnaces



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

10410 Co-step furnaces



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

10430 Bogie hearth furnaces



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

10460 Chamber furnaces



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

16.08 Heating furnaces and heat treatment plants

10510 Roller hearth and walking beam furnaces



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

10540 Pusher-type, roller and rotary hearth furnaces



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

10560 Heat treatment plants



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

10562 Heat treatment furnaces (continuous and discontinuous)



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

10570 Heat treatment furnaces for batch operation, open heated



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

16.09 Bath furnaces

10580 Aluminum melting furnaces



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

16.13 Components

10890 Natural gas burners



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

16.13 Components

11070 Radiant tube burners



WS Wärmeprozess-technik 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
 Internet:

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, lick-ers
- 1010 Scrap shears
- 1015 Scrap shear blades
- 1017 Scrap magnets
- 1020 Shredder plants
- 1021 Safety equipment for electric load lifting magnets
- 1022 Separation magnets
- 1030 Chip crusher

02.09. Other equipment

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

03 Iron making

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

03.01. Blast furnaces

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

03.02. Direct reduction plants

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

03.03. Cupola furnaces

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

03.04. Components

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

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

03.05. Blast furnace products for foundries

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

03.06. By-products

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

04 Steelmaking

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

04.01. Hot metal preparation plants

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

04.02. Converter

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

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

04.03. Energy optimization furnaces

- 1770 Energy optimization furnaces

04.04. Electric steel plant

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

04.05. Induction furnaces

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

04.06. Vacuum furnaces

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

04.07. Secondary metallurgy

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

04.08. Tertiary metallurgy

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

04.09. Components

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

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

04.10. Steel mill supplies

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

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

04.11. Preparation of steel mill materials

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

04.12. Services

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

05 Continuous casting

- 2960 Engineering and technical assistance

05.01. Continuous casting plants of various designs

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

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

05.02. Continuous casting plants for different product dimensions

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

05.03. Spray compacting plants

- 3090 Spray compacting plants

05.04. Components

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

- 3346 Marking machines
- 3350 Emergency cutting torches
- 3355 Optical product recognition (OPR) for marked billets
- 3360 Plasma tundish heating
- 3370 Plate molds
- 3380 Precision stopper device
- 3390 Tube molds
- 3400 Shadow tube manipulators
- 3405 Safety device for electrolift magnets
- 3410 Marking colors
- 3415 Slab magnets
- 3420 Stamping machines
- 3422 Stamping machines, hydraulic or pneumatic drive
- 3429 Continuous casting molds
- 3430 Continuous casting molds (also made of electrographite)
- 3440 Continuous casting rolls
- 3450 Tundish heating
- 3460 Tundish (manifold) plasma heater
- 3470 Tundish flow control
- 3480 Tundish gate valve (Tundish gate valve)
- 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

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

10.05. Rolls for cold rolling mills

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

10.06. Components

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

10.07. Operating materials

- 5960 Lubricants for cold rolling

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

11.02. Pickling plants

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

11.03. Grinding and polishing machines

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

11.04. Surface treatment plants

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

10 Cold rolling

- 5480 Engineering and technical assistance

10.01. Cold rolling mills

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

10.02. Skin pass mills

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

10.03. Finishing lines

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

10.04. Annealing lines

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

11 Surface treatment

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

11.01. Descaling equipment

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

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

11.05. Aluminizing, tin plating, galvanizing

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

11.06. Corrosion protection

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

11.07. Components

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

11.08. Operating materials

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

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

11.09. Services

- 6906 Large format surface grinding
- 6910 Contract finishing

11.10. Wear protection

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

12 Production of bright steel and wire

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

12.01. Wire rod mills

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

12.02. Wire, bar and profile drawing

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

12.03. Finishing lines for drawing shops

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

12.04. Components

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

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

12.05. Operating supplies

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

13 Production of tubes / pipes

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

13.01. Tube rolling mills

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

13.02. Tube drawing machines

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

13.03. Pipe welding machines

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

13.04. Finishing lines for tubes

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

13.05. Components

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

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

14 Sheet metal processing

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

14.01. Plants, presses, machines

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

14.02. Slitting lines

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

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

14.03. Welding technology

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

14.04. Components

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

14.05. Services

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

15 Steel products

15.01. Rolled steel

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

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

15.02. Pipes

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

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

15.03. Forgings

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

15.04. Railroad rolling stock

- 9540 Axles
- 9550 Wheel tires

15.05. Steel in the following delivery forms

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

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

15.06. Drawing and cold rolling mill products

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

15.07. Wire and wire products

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

15.08. Steel construction

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

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

15.09. Services

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

16 Furnace and energy technology

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

16.01. Rolling mill furnaces

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

16.02. Forging furnaces

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

16.03. Roller Hearth Continuous Furnaces

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

16.04. Continuous furnaces for wide strip

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

16.05. Top-hat furnaces

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

16.06. Vacuum furnaces

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

16.07. Hardening and tempering equipment

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

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

16.08. Heating furnaces and heat treatment plants

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

16.09. Bath furnaces

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

16.10. Industrial furnaces for special purposes

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

16.11. Protective gas plants

- 10670 Protective gas plants

16.12. Insulations

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

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

16.13. Components

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

16.14. Operating materials

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

- 11160 Polymer solutions
- 11170 Lubricants
- 11180 Spray cleaners
- 11190 Heat transfer fluids

16.15. Services

- 11200 Energy consulting
- 11210 Energy saving
- 11215 Commissioning, maintenance and service of heating equipment
- 11240 Planning and projecting of energy-technical plants

17 Refractory technology

- 11245 Product know-how for basic refractory bricks and mixes
- 11248 Monitoring of refractory components

17.01. Raw materials, precursors and binders for refractory materials

- 11250 Aluminum hydroxide
- 11260 Alumina, alumina
- 11263 Reinforcing wires for refractory mixes
- 11265 Binders for the production of refractory materials
- 11270 Electrocorundum
- 11280 Graphite
- 11290 Adhesive sand
- 11300 Coke breeze
- 11310 Coke breeze, dry
- 11320 Magnesium oxide
- 11330 Microsilica
- 11360 Silicon carbide
- 11366 Titanium dioxide
- 11370 Clays
- 11380 Alumina specialties
- 11390 Zirconia

17.02. Plants for the production of refractory materials

- 11400 Equipment for the production of refractory materials

17.03. Refractory materials and equipment

- 11410 Tapping stones for converters and electric arc furnaces
- 11420 Painting, filling and plastering materials
- 11430 Basic ramming, gunning and casting mixes
- 11440 Basic bricks (magnesia, magnesia-chromium, chromium ore, chromite, dolomite, spinel, forsterite and carbon bricks)
- 11450 Calcium silicate
- 11460 Dolomite products
- 11470 Electrode masses
- 11480 Fiber ceramic moldings, vacuum formed
- 11481 Fiber ceramic moldings, vacuum formed, up to 1750 °C
- 11485 Fiber mats and felts up to 1600 °C
- 11490 Fiber products, ceramic
- 11500 Prefabricated parts, refractory
- 11510 Refractory concrete

- 11512 Refractory concrete, high strength, for industrial floors

- 11520 Refractory products, general
- 11530 Refractory ramming mixes
- 11540 Refractory anchorages
- 11550 Refractory material
- 11560 Lightweight refractory bricks
- 11570 Lightweight refractory and insulating mixes
- 11580 Lightweight refractory and insulating bricks
- 11590 Gas purging equipment, refractory
- 11600 Pouring mixes, self-flowing
- 11610 hearth masses
- 11620 High-fire bricks
- 11630 Blast furnace bricks
- 11640 Induction furnace mixes
- 11650 Insulating material, asbestos-free
- 11660 Isostatically pressed products
- 11670 Carbon and graphite bricks
- 11690 Converter bricks
- 11700 Arc furnace bricks
- 11710 Perforated bricks
- 11720 Masses, refractory (general)
- 11725 MgO-C bricks
- 11730 Mortars and mastics, refractory
- 11740 Mux masses
- 11750 Ladle masses
- 11752 Torpedo ladle lining
- 11755 Ladle lining, monolithic
- 11760 Ladle bricks
- 11768 Products made of \ 050HTW \ 051 high temperature wool
- 11790 Gutter and taphole masses
- 11800 Gutter lining, cooled
- 11810 Acid resistant bricks
- 11820 Acid ramming and centrifugal masses
- 11830 Firebricks
- 11840 Shadow pipe
- 11850 Slide gate ceramics
- 11860 Cast basalt
- 11865 Protective blankets made of textile fabric, refractory
- 11870 Silicon carbide bricks
- 11880 Silica bricks, tondina bricks
- 11886 Special adhesives up to 1200 °C
- 11890 gunning and repair compounds
- 11900 Steel mill wear material
- 11910 ramming, casting and vibrating masses
- 11915 ramming, spraying and casting compounds
- 11920 Stoppers and spouts
- 11930 Continuous castings, refractory
- 11940 Immersion tube, monota immersion spout
- 11950 Technical ceramics
- 11960 High-alumina bricks (andalusite, bauxite, corundum, mullite, sillimanite bricks)
- 11970 Torpedo mixer stones
- 11980 Tundish masses
- 11985 Pouring compounds, cement-free, for blast furnace tapping troughs
- 11990 Vermiculite
- 12000 Thermal insulation materials, asbestos-free
- 12004 Vacuum formed parts
- 12005 Vacuum formed parts, without ceramic fibers
- 12010 Wollastonite

- 12020 Zircon nozzles
- 12030 Zircon containing stones
- 12040 Zircon sand / flour)

17.04. Processing of refractory materials

- 12050 Processing of used refractory materials
- 12060 Testing of FF materials

17.05. Machines for refractory construction

- 12070 break-out hammers, pneumatic and hydraulic, for electric furnaces, converters, ladles and troughs
- 12071 Excavation robots
- 12075 Chipper
- 12080 Converter tap hole repair vehicles
- 12095 Converter lining devices
- 12100 Manipulators for FF masses
- 12110 Ladle spraying machines
- 12118 Pumping machines for refractory materials
- 12120 Pumping machines for refractory materials
- 12130 Centrifugal machines for FF-masses
- 12140 Spraying machines for FF materials
- 12150 Tamping plants, autom., for ladles

17.06. Refractory construction

- 12160 lining of all kinds of furnaces
- 12170 Firing chambers
- 12175 Refractory anchors
- 12180 Refractory construction
- 12190 Refractory ramming mixes
- 12200 Suspended ceilings

17.07. Services

- 12204 Training - Refractory
- 12205 Refractory maintenance at operating temperature
- 12206 Refractory systems

18 Machinery and plant engineering

- 12210 Plant engineering, general
- 12220 CAD design
- 12230 Engineering and technical assistance
- 12240 beams, columns, shafts
- 12250 Industrial Engineering
- 12258 Standard parts for cutting and punching tool construction
- 12260 Cleaning and cleaning materials
- 12270 Second-hand machines (purchase and sale)
- 12280 Special constructions
- 12285 Heat exchangers
- 18.01. Mining equipment, machines and supplies
- 12290 Plants and machines for underground mining
- 12300 Bucket elevators
- 12309 Conveyor systems
- 12310 Conveying plants and machines
- 12330 Mine support profiles

18.02. Chemical plants and accessories

- 12350 Tank and apparatus construction
- 12360 Liquid gas - storage stations
- 12370 Gas tanks
- 12390 Acid chimneys
- 12400 Acid and chemical resistant plants and equipment
- 12410 Nitrogen production plants

18.03. Steam generation plants and equipment

- 12425 Exhaust gas technology
- 12430 Waste heat boilers
- 12440 Steam filters
- 12450 Steam boilers, general
- 12460 Pressure boilers
- 12470 Hydrazine removal
- 12480 Pulverized coal firing systems

18.04. Foundry equipment, machinery and supplies

- 12354 Casting ladles
- 12500 Molding machines
- 12530 Foundry equipment, machines and supplies
- 12535 Foundry tools
- 12540 Foundry consulting and engineering
- 12542 Foundry software
- 12550 Core shooters
- 12560 fettling machines
- 12570 Robots
- 12580 Sand mixers
- 12586 Melting furnaces, inductive
- 12590 Shaking ladles
- 12592 Crucible tongs
- 12605 Vacuum investment casting plants-superalloys
- 12607 Vacuum investment casting plants with cold crucibles for titanium or titanium alloys

18.05. Power plants and power stations

- 12610 Power plants and power stations, steam
- 12620 Power plants and power stations, electric

18.06. Ventilation plants and equipment

- 12630 Blowers
- 12635 Industrial fans
- 12650 Air conditioners, general
- 12660 Air conditioners for heat plants
- 12670 Air conditioners for crane lances, crane bridges, etc.
- 12690 Expansion joints
- 12700 Ventilation ducts
- 12710 Ventilation systems and equipment, general
- 12720 Natural ventilation
- 12730 Induced draught systems and equipment
- 12740 Ventilators

18.07. Water treatment plants, equipment and accessories

- 12750 Chemical water treatment
- 12760 Pressurized water plants and accumulators
- 12770 Filtering plants for circulating water
- 12780 Rubber compensators

- 12790 Cooling towers
- 12793 Cooling water / circulating water systems
- 12796 Magnetic filters
- 12800 Press water additives
- 12810 Water treatment systems
- 12830 Water demineralization, treatment and recycling
- 12840 Water recooling systems
- 12846 Water filtration

18.08. Other plants

- 12848 Chillers
- 12850 Slag granulation hoses
- 12860 Slag recycling plants (also slag granulation plants)
- 12862 Slag granulation plants
- 12870 Lube oil plants

18.09. Maintenance

- 12880 Spare parts and consumables
- 12890 Maintenance, general
- 12892 Maintenance organization
- 12894 Maintenance systems
- 12896 Repair, overhaul and modernization of machine tools
- 12900 Maintenance of large gear units
- 12920 Maintenance of continuous casting plants for ingots and slabs
- 12930 Maintenance of continuous casters for ingots and billets
- 12950 Repair of ingot molds
- 12960 Repair of ingot molds
- 12964 Cooling system cleaning
- 12970 Ladle repair, FF
- 12980 Repairs, spare parts
- 12983 Software for maintenance
- 12990 Preventive maintenance
- 13000 Heat exchanger cleaning
- 13010 Condition based machine maintenance

18.10. Power and work machines

- 13020 Steam turbines
- 13021 Gas turbines
- 13030 Rotary compressors
- 13040 Compressed air equipment
- 13050 Natural gas, gas transmission compressor stations
- 13060 Natural gas HP storage
- 13070 Piston pumps
- 13080 Piston compressors
- 13083 Corrosion resistant pumps
- 13090 Centrifugal pumps
- 13100 Mixing units for all fuel gases
- 13120 Lubrication pumps
- 13130 Screw compressors
- 13150 Turbo compressors
- 13160 Vacuum pumps

18.11. Gearboxes and drive elements

- 13168 Drive elements
- 13170 Drive engineering
- 13174 Valve gearboxes
- 13180 Brakes
- 13190 Brake disc mounting
- 13195 Torque limiter
- 13200 Flange couplings

- 13210 Cardan joints
- 13220 Cardan shafts
- 13230 Gear rollers
- 13240 Gearboxes and drive elements
- 13250 Large gearboxes
- 13255 Chain drives and sprockets
- 13260 Hirth serration
- 13261 Hirth spur gearing
- 13270 Couplings
- 13285 Couplings, flexible, elastic
- 13290 Couplings, mechanical and hydrodynamic
- 13300 Planetary gearboxes
- 13308 Slew drives
- 13310 Safety couplings
- 13318 Spindles
- 13320 Special constructions
- 13350 Shaft-hub couplings (backlash-free)
- 13360 Shaft couplings (rigid)
- 13370 Winding shafts
- 13380 Gear drives
- 13390 Gear wheels
- 13395 Gearbox repairs

18.12. Bearings

- 13400 Slewing rings
- 13404 Elastomeric bearings
- 13406 Spherical plain bearings / rod ends
- 13410 Plain bearings
- 13420 Ceramic-metal compact plain bearings
- 13430 Ball bearings
- 13440 Cam rollers
- 13460 Linear systems
- 13470 Roller bearings
- 13480 Yoke type track rollers
- 13484 Thermal separation
- 13485 Support and guide rollers
- 13490 Rolling bearings
- 13492 High-temperature rolling bearings
- 13500 Roller bearings

18.13. Oil hydraulic systems, equipment and accessories

- 13508 Rotary distributors
- 13510 Rotary feeders
- 13520 Pressure measuring, switching and writing devices
- 13530 Pressure switch
- 13540 High pressure flange connectors
- 13550 Hydraulic systems
- 13560 Hydraulic and shaft seals
- 13570 Hydro gears
- 13580 Hydro motors
- 13590 Hydro pumps
- 13595 Hydraulic accumulators
- 13600 Hydro valves
- 13610 Hydraulic cylinders
- 13620 Oil hydraulic systems, devices and accessories
- 13630 Vibration dampers
- 13640 Servo valves
- 13645 Continuous valves
- 13660 Complete plants, oil hydraulic
- 13670 Water hydraulic

18.14. Control systems and components

- 13680 Shut-off valves

- 13690 Automatic inflow control with distribution gate valves
- 13695 Torque limiters
- 13710 Electro-hydraulic actuators
- 13718 Electro-servo cylinders
- 13720 Multipoint single and multi-purpose regulators
- 13730 Control systems, complete
- 13740 Control valves
- 13760 Actuators
- 13780 Continuous single and multi-purpose regulators

18.15. Piping and accessories

- 13786 Exhaust gas technology
- 13790 Butterfly valves
- 13800 Asbestos-free fabric expansion joints
- 13810 Fittings
- 13820 Flanges
- 13840 Rubber expansion joints
- 13850 High pressure pipe technology
- 13859 Safety valves
- 13860 Expansion joints
- 13890 Pipe break safety valves
- 13900 Pipe swivels
- 13910 Piping and accessories
- 13920 Pipeline construction
- 13930 Piping accessories
- 13940 Check valves
- 13945 Hoses
- 13947 Flexible hoses with ceramic wear protection
- 13950 Plug-in disc gate valves

18.16. Stranding machines

- 13955 Stranding machines
- 13958 Rope making machines

18.17. Tool and model making

- 13956 Mold frames, mold assemblies
- 13960 Materials for model and prototype construction
- 13970 Model and prototype making

18.18. Machine tools

- 13980 Cutting-off machines
- 13990 External thread cutting machines
- 14000 Band sawing machines
- 14010 Bending and straightening machines
- 14015 Slab sawing machines
- 14020 Wire working and processing machines
- 14030 Flow-forming machines
- 14040 Milling machines
- 14060 Spark erosion machines
- 14070 honing and lapping machines
- 14080 Cable sheathing presses
- 14081 Cable sheathing presses (lead and aluminum)
- 14088 Sharpening machines
- 14090 Cold circular saws
- 14095 Hot circular saws
- 14100 Mould processing machines
- 14120 profile and flat shears
- 14130 Shears (standing, flying) for metallurgical operations
- 14140 Shears (standing, flying) for sheet metal working

- 14150 Shearing centers
- 14160 Grinding and polishing machines (also internal)
- 14170 Special machines for chip forming
- 14180 Special machines for chipless forming
- 14190 Special machines for special tasks
- 14195 Concrete sawing machines
- 14200 Stone cutting saws
- 14210 Plate shears
- 14220 Cut-off machines

18.19. Tools

- 14230 Press brake tools
- 14240 Drills
- 14242 Taphole drilling tools
- 14250 Diamond tools
- 14260 Pneumatic tools
- 14280 Carbide (also metal carbide)
- 14290 Tungsten carbide inserts and molded parts
- 14300 Carbide tools
- 14302 HM tipped saw blades
- 14304 HP grinding wheels
- 14306 Saw bands and blades for metallic and non-metallic materials
- 14310 Saw blades for metal
- 14318 Cutters
- 14320 Shear blades
- 14323 Splitting knives and accessories for splitting lines
- 14330 Abrasives and grinding wheels
- 14334 Special tools for die casting industry
- 14336 Cutting wheels
- 14337 Roll grinding wheels
- 14338 Cutting and special tools

18.20. Clamping technology

- 14380 Clamping hydraulics
- 14400 Clamping elements
- 14401 Clamping tools, screws

18.21. Components

- 14410 Seals
- 14412 Seals with high chemical and thermal resistance
- 14420 Rotary seals for feeding gases or liquid media
- 14430 Cooling water circulation units for continuous casting-rolling lines
- 14440 Nozzles (also blow-off and descaling nozzles)
- 14450 Pistons
- 14460 Metal hoses
- 14470 Buffers (rubber and cellular buffers)
- 14480 Stuffing box packings
- 14490 Wear plates

18.22. Operating fluids

- 14500 Solid lubricants
- 14510 Industrial oils
- 14520 Cooling lubricants

18.23. Tribology

- 14522 Dosing and monitoring equipment for lubricants

- 14523 Oil circulation systems for bearing and gear lubrication
- 14524 Two-line grease lubrication systems for metallurgical plants and rolling mills
- 14525 Special lubricants
- 14526 Central lubrication systems
- 14527 Machines for degreasing and lubrication

18.24. Services

- 14528 Service for compressors and turbines
- 14529 Mechanical processing of hydraulic parts

19 Transport and storage technique

- 14530 Engineering and technical assistance
- 14535 Hot material conveyors
- 14540 Transport and logistics for industrial residues
- 14545 Hot material conveyors
- 14548 Transport
- 14550 Transport technology

19.01. Metallurgical plant vehicles

- 14560 Slab, bloom and billet transporters, rubber tires
- 14570 Coil transport systems
- 14580 Coil transporters
- 14590 Steel mill vehicles, general
- 14600 Metallurgical plant vehicles, track-bound
- 14605 Air cushion vehicles-FTS
- 14610 Slag ladle transporters
- 14620 Slag transporter
- 14630 Scrap transport trailers with weighing equipment
- 14640 Steel mill vehicles

19.02. Rail vehicles

- 14650 Diesel locomotives
- 14660 Railroad wagons
- 14670 Self-propelled wagons

19.03. Track technology

- 14680 Turntables and transfer cars
- 14684 Track technology
- 14690 Shunting systems

19.04. Trackless vehicles

- 14700 Trailers
- 14705 Trucks and trailers
- 14720 Electric industrial trucks
- 14730 Electric trucks
- 14734 Electric four-way sideloaders
- 14740 Driverless transport systems
- 14742 Driverless transport systems for steel and aluminum coils
- 14750 Forklifts and cross stackers
- 14760 Rubber-tired heavy-duty transport vehicles
- 14810 Heavy-duty tractors
- 14820 Telescopic excavators
- 14822 Transport systems for coils

19.05. Continuous conveyors

- 14830 Conveyors (general)

- 14840 Pneumatic conveyors
- 14850 Vibratory conveyors
- 14860 Vertical conveyors
- 14880 Steep conveyors
- 14890 Continuous conveyors for bulk material
- 14900 Continuous conveyors for piece goods
- 14910 Conveyor belts and screws
- 14920 Trough chain conveyors

19.06. Cranes

- 14930 Slewing cranes
- 14940 Casting cranes
- 14945 Crane systems, automatic
- 14946 High capacity automatic cranes
- 14950 Cranes, hoists and accessories, general
- 14955 Crane service
- 14960 Overhead travelling cranes
- 14970 Gantry cranes
- 14980 Bracket cranes
- 14990 Buffers
- 14992 Vacuum lifting devices for heavy industry
- 14993 Automatic stacking devices (vacuum lifting devices)

19.07. Scales

- 14997 Bundle and coil scales
- 15000 Batching and blending scales
- 15010 Track and truck scales
- 15020 Crane scales
- 15030 Roller table scales
- 15040 Scales for continuous weighing
- 15041 Scales for alloying elements
- 15042 Scales for pig iron
- 15043 Scales for scrap
- 15044 Scales for static weighing
- 15045 Scales for stationary weighing
- 15050 Weighing systems for ladle turrets and ladle cars
- 15060 Load cells
- 15080 Weighing systems for silos

19.08. Storage and retrieval systems

- 15090 Bund high-bay warehouse
- 15100 Container staging systems
- 15110 Labeling systems
- 15120 Lattice girder storage systems
- 15130 Manual overhead conveyors
- 15134 Aerial work platforms
- 15140 Storage technology and automation systems for sheet metal, long goods and stacking boxes
- 15141 Storage technology and automation systems for sheet metal, long goods and stacking boxes
- 15150 Storage and retrieval systems
- 15155 Storage systems for coils
- 15160 Storage and racking systems
- 15164 Long goods order pickers, high rack stackers
- 15170 Marking systems
- 15180 Pallets and cassettes
- 15188 Vertical elevators (paternosters)
- 15190 Stacker cranes
- 15193 Traversers and turning devices
- 15195 Honeycomb racking systems

19.09. Warehouse organization

- 15198 Labels
- 15200 Identification
- 15208 Warehouse logistics
- 15210 warehouse organization)

19.10. Components

- 15220 Slings equipment
- 15230 Loading and unloading equipment
- 15240 Sheet metal package tongs
- 15250 block pushers, extractors
- 15270 Bunker discharge aid
- 15280 Bunker and silo equipment
- 15290 Coil and sheet metal packaging
- 15300 Coil tongs
- 15310 Permanent magnets
- 15320 Electrical equipment for cranes etc.
- 15330 Electric hoists
- 15333 Distance measuring devices for cranes
- 15335 Labels
- 15340 Conveyor belt cover
- 15350 Conveyor belt scraper
- 15360 Conveyor devices and equipment
- 15370 Conveyor belt splices
- 15380 Conveyor belt vulcanizing equipment and material
- 15390 Grippers and tongs
- 15400 Handling machines
- 15410 Lifting clamps, safety lifting clamps
- 15420 Industrial robots, metallurgical, sensor controlled
- 15430 Chains
- 15431 Sprockets
- 15440 Tipping eyes, tipping shackles
- 15450 Crane wheels
- 15455 Crane ropes
- 15460 Storage yard equipment
- 15470 Laser distance measuring devices for cranes
- 15480 Load lifting belts
- 15490 Lifting magnets and equipment
- 15500 Magnetic brakes
- 15510 Magnets, magnet systems
- 15511 EGIS safety device for electric lifting magnets
- 15520 Wheels
- 15530 Corrosion, friction and wear protection
- 15540 Bulk containers
- 15550 Pulleys
- 15555 Safety device for electric load lifting magnets
- 15560 Separation magnets
- 15570 Silos for FF-masses
- 15580 Silos for bulk materials
- 15590 Handling plants for bulk materials
- 15600 Deflection rollers
- 15610 Packaging technology
- 15620 Wear protection coatings with aluminum oxide ceramics
- 15630 Wear protection coatings with rubber
- 15632 Wear protection technology
- 15635 Track-bound tippers
- 15640 Wagon tipper
- 15650 Hot transport and cooling hoods for steel ingots
- 15652 Weighing systems for steel production

19.11. Operating materials

- 15660 Lubricants

19.12. Packaging technology

- 15662 Automated packing stations for coils and long goods
- 15664 Packaging materials

20 Electrical engineering and automation

- 15670 Electromechanical actuators
- 15680 Engineering and technical assistance
- 15690 Technical translations and documentation
- 20.01. Electrical equipment for metallurgical plants and rolling mills**
- 15700 Workplace design systems
- 15720 Three-phase motors
- 15730 Electrical equipment for metallurgical plants and rolling mills
- 15740 Electrical equipment for rolling mills
- 15750 Large electrical installations, complete
- 15760 Power supply systems for mobile consumers
- 15770 Spring cable reels
- 15780 Spring hose reels
- 15785 Radio remote controls
- 15788 Radio systems
- 15790 Radio control systems
- 15800 Gear motors
- 15810 DC motors
- 15820 High current cables and lines, water cooled
- 15830 Cables and wires
- 15840 Cables, cable reels and accessories
- 15850 Motorized cable reels
- 15860 Low voltage switchgears and installations
- 15870 Switchgears
- 15880 Slip ring bodies
- 15890 Fuse systems
- 15900 Heavy current capacitors
- 15910 Plugs and socket-outlets
- 15920 Power converters (frequency converters)
- 15930 Power supply systems (movable and also busbars)
- 15940 transformers (also for industrial furnaces)
- 15960 AC and intercom systems
- 15962 High voltage feeders and contacts
- 20.02. Control and automation systems**
- 15967 Electrical, instrumentation and control engineering, general
- 15968 Installations for anisotropic control technology
- 15970 Automation, general
- 15980 Automation plants for ore and fine ore
- 15990 Automation plants for blast furnaces
- 16000 Automation plants for industrial furnaces, general
- 16010 Automation plants for cold rolling mills
- 16020 Automation plants for coking plants
- 16030 Automation systems for steel mills
- 16035 Automation systems for blast furnaces

- 16040 Automation systems for hot rolling mills and tube mills
- 16041 Automation systems for hot rolling mills
- 16050 Automation plants and process control systems in metallurgical plants and rolling mills
- 16055 Automation of strip processing lines
- 16060 Automatic detection systems
- 16063 Strip guiding systems
- 16070 Data transmission equipment and systems
- 16080 Industrial television technology
- 16090 Information and communication systems
- 16100 Identification
- 16110 Customized complete systems
- 16120 Guidance systems (inductive) for vehicles
- 16130 Control systems (by image processing) for vehicles
- 16140 Control and automation systems, general
- 16150 Positioning systems for cranes
- 16160 Process automation
- 16162 Process automation for strip processing lines
- 16170 Process automation for continuous steel casting plants
- 16180 Process automation for metallurgical plants
- 16190 Process control systems
- 16192 Process control with infrared detectors
- 16200 Process optimization
- 16202 Process optimization with weighing systems
- 16205 Shopfloor systems
- 16210 Control systems, complete
- 16220 Control stations for metallurgical and rolling mill plants
- 16230 Control systems, electrical
- 16240 Control systems, electronic
- 16250 Control systems for press water tanks
- 16260 Control systems, hydraulic
- 16270 Control systems, infrared
- 16280 Power supplies for automation and control
- 16290 Networking
- 16293 Video technology
- 16295 Weighing systems for process automation in steelworks

20.03. Data processing

- 16300 Analog devices and accessories
- 16305 Archiving
- 16310 Production and machine data acquisition BDE/MDE
- 16320 Data acquisition devices and systems
- 16330 Data processing
- 16338 Digital image processing
- 16340 Digital devices and accessories
- 16350 Expert systems
- 16355 Manufacturing Execution System (MES)
- 16360 Turnkey system solutions, hardware \ 057software
- 16380 X-Window Terminal

20.04. Software

- 16390 Simulation software
- 16393 Software for archiving, document management and workflow

- 16395 Software for order processing, warehouse and test certificate management
- 16400 Application software
- 16410 Software for slitting lines
- 16415 Enterprise resource planning system for metal and steel trade
- 16420 Software for production planning and control
- 16430 Software for statistical process control and quality assurance
- 16440 Technical calculation programs
- 20.05. Maintenance**
- 16450 Machine diagnostics
- 16460 Maintenance and inspection

21 Measuring and testing technique

- 16470 Gas measuring instruments for degreasing plants
- 16472 Gas measuring devices for metal degreasing plants
- 16480 Gas measuring devices for metal cleaning plants
- 16488 Multichannel measuring systems
- 21.01. Measuring and testing technology, general**
- 16490 Automation and metrology, color measurement
- 16500 Pressure transducers
- 16508 Corrosion testers
- 16510 Metrology
- 16511 Measuring magnetism
- 16520 Measuring and testing systems, general
- 16530 Measuring and testing systems, general
- 16540 Measurement value acquisition
- 16550 Measured value processing
- 16552 Measuring and test equipment identification labels
- 16553 Measuring equipment and test status identification labels
- 16560 Radioactivity warning systems
- 16564 Recorder systems, paperless
- 16566 Pre-warning of melt breakthroughs and residual wall thickness measurement on refractory linings
- 16568 Roll gauges
- 21.02. Measurement of physical properties**
- 16570 Distance measuring system
- 16580 Distance sensors for positioning and length measurement (laser, ultrasonic, optical, inductive and capacitive)
- 16581 Distance sensors for positioning and length measurement (magnetostrictive)
- 16590 Bath mirror measurement in converter
- 16600 Bath mirror control
- 16608 Strip thickness control (AGC)
- 16610 Strip sag measuring device
- 16612 Strip flatness measurement
- 16613 Strip flatness control
- 16615 Strip guiding system
- 16620 Tape tension measuring systems

- 16625 Tension measuring system for driven S-rolls
- 16630 Width measuring devices
- 16640 Strain gauges and measuring strips
- 16645 Strain measuring systems
- 16650 Strain and mass flow measuring systems
- 16652 Dressing degree and mass flow measuring systems
- 16660 Thickness measuring systems and devices
- 16670 Thickness gauges
- 16680 Distance switches and measuring devices (optical, acoustic and inductive)
- 16690 Torque measuring devices for S-rollers
- 16700 Torque measuring device
- 16710 Speed measuring devices
- 16720 Flow meters
- 16721 Flow measuring devices, capacitive, e.g. for coal injection
- 16730 Flow monitoring
- 16740 Diameter measurement
- 16750 Electrical measurement of mechanical quantities
- 16755 Electronic measuring system for hydraulic and lubricating oils
- 16770 Form measurement
- 16780 Level measuring devices
- 16790 Level control
- 16800 Level control
- 16810 Gas measuring instruments
- 16815 Oxygen sensors for waste gas
- 16820 Equipment and chemicals for waste water control
- 16830 Speed measuring devices
- 16850 Infrared switch
- 16860 Infrared radiation pyrometer
- 16861 Infrared radiation thermometer with scanner
- 16870 Infrared radiation pyrometer with scanner
- 16871 Infrared Radiation Thermometer
- 16875 Infrared thermography
- 16877 IR camera - infrared based slag detection
- 16878 Cameras, furnace cameras
- 16879 Cast iron temperature measurement
- 16880 Insulating capillary
- 16890 Force measuring devices for tension and compression
- 16891 Force measurement and weighing systems
- 16892 Force measuring systems
- 16900 Cooling water monitoring
- 16910 Length measuring devices for tubes
- 16920 Linear encoders
- 16930 Linear encoders (also for ways and distances)
- 16940 Linear encoders, ultrasonic (also for ways and distances)
- 16950 Length and speed measuring systems (optical)
- 16960 Laser speed and length measuring systems
- 16970 Conductivity and pH meters
- 16980 Mass flow meters
- 17000 Measurement of refractory linings (in operating condition)
- 17010 Measuring devices for electrical quantities
- 17020 Measuring machines

- 17030 Measurement printers
- 17033 Microstructure/roughness measurement
- 17035 Surface crack detection
- 17040 Opto-electronic measuring instruments
- 17050 Flatness measuring devices
- 17057 Profile measuring devices
- 17060 Profile measuring systems (non-contact)
- 17080 Pyrometer
- 17090 Pyrometer tubes
- 17100 Ratio pyrometer
- 17105 Inline concentration measurement of liquids
- 17110 Probes for liquid pig iron
- 17120 Tube measuring equipment
- 17130 Coating thickness gauges
- 17133 Coating thickness control
- 17135 Layer thickness control
- 17138 Slag detection with infrared
- 17140 Slag detectors
- 17160 Forging measurement
- 17180 Vibration measuring devices
- 17190 Rope testing equipment for round and flat steel ropes (rope belt conveyors)
- 17200 Dust measuring equipment
- 17210 Equipment for radiation measurements
- 17220 Systems for nuclear radiation measurement (input control)
- 17230 Immersion thermocouples
- 17250 Temperature measurement equipment
- 17255 Temperature profile measuring systems
- 17260 Thermocouples
- 17270 Thermocouple protection tubes
- 17274 Thermographic measurement
- 17280 Thermal conductivity measuring systems
- 17290 Rolling mill force measuring systems
- 17300 Rolling mill measuring systems
- 17310 Resistance thermometers
- 17320 Line scan cameras
- 17322 Non-destructive thickness measurement of refractory linings (during furnace shutdown)
- 17325 2-color pyrometer with fiber optics

21.03. Quality management

- 17340 3-D profile measurement of rails and other profiles
- 17341 3-D profile measurement of weld seams
- 17345 Pickling bath monitoring
- 17350 Breakdown early detection
- 17352 Breakdown early detection and monitoring
- 17360 Breakdown monitoring
- 17365 Chrome bath monitoring
- 17368 Roller emulsion control
- 17370 In-line surface inspection, optical
- 17380 Measuring instruments for quality management
- 17384 Mold control
- 17390 Length, speed and profile measuring systems
- 17400 Hole detection
- 17408 Surface inspection
- 17409 Surface inspection systems
- 17410 Surface inspection
- 17415 Surface inspection of strip steel
- 17426 On-line measurement of oils and waxes
- 17430 On-line surface inspection, optical
- 17432 On-line surface quality inspection, optical

- 17440 On-line roughness measurement
- 17445 Systems for quality data acquisition and processing

21.04. Quality control

- 17446 Strip edge inspection
- 17447 Strip steel surface inspection, automatic and complete
- 17448 Strip steel surface inspection, automatic and complete
- 17450 Quality control, visual
- 17460 Testing services

21.05. Services

- 17470 Metrology services

22 Materials testing

- 17473 Destructive and non-destructive materials testing

22.01. Non-destructive materials testing

- 17480 Consulting, execution, equipment
- 17490 Image processing, barcode readers
- 17500 Demagnetization equipment
- 17510 Internal pressure testing equipment
- 17520 Corrosion testing
- 17530 Measuring and testing machines
- 17536 Training and certification for NDT
- 17540 Ultrasonic testing equipment/machines
- 17560 Non-destructive testing of round and flat steel cables
- 17570 Non-destructive pipe testing equipment
- 17580 Non-destructive material testing equipment, general
- 17589 Non-destructive material testing equipment, acoustic
- 17590 Non-destructive material testing equipment, electromagnetic
- 17620 Non-destructive material testing equipment, optical
- 17630 Non-destructive materials testing with X-rays
- 17640 Non-destructive materials testing with acoustic emission analysis
- 17650 Non-destructive materials testing equipment with ultrasound
- 17660 Non-destructive materials testing
- 17664 Non-destructive materials testing with fluorescent and red/white penetrant methods
- 17665 Non-destructive material testing with fluorescent and red/white test method
- 17670 Non-destructive materials testing with coupling agent-free ultrasonic excitation
- 17680 Non-destructive materials testing, optoelectronic
- 17690 Non-destructive materials testing (service)

22.02. Strength testing, endurance testing

- 17698 Fixtures for tensile testing
- 17700 Stress analyses and reliability tests on machines and components
- 17710 Consulting, execution, equipment
- 17720 Fatigue testing machines

- 17730 Hardness testers
- 17740 Hardness testing equipment
- 17750 Machines for tensile test preparation
- 17760 Friction and wear testing machines
- 17770 Crack testing machines
- 17780 Pipe testing presses
- 17790 Torsion testing machines
- 17800 Universal testing machines for tension, compression, bending and tensile tests

22.03. Technological testing methods, testing service

- 17810 Chemical analyses
- 17820 Grain size analysis
- 17830 Mechanical-technological testing
- 17840 Metallographic testing
- 17850 Technological testing
- 17852 Technological testing, microscope image analysis
- 17860 Deep drawing testing machines for sheets and strips
- 17870 Conversion of conventional universal testing machines to electronic measurement with data processing
- 17880 Roll testing (concentricity, eccentricity)

22.04. Destructive material testing

- 17888 Corrosion testing
- 17890 Machines for the production of notched bar impact specimens

22.05. Fatigue testing

- 17896 Testing of safety valves in operating condition

22.06. Damage analysis

- 17898 Damage analysis

23 Analysis and laboratory equipment

- 17900 Engineering and technical assistance

23.01. Sampling and sample preparation

- 17910 Gas probes, gas sampling probes
- 17915 Sampling
- 17920 Sampling equipment
- 17940 Sample punching
- 17950 Sample transport
- 17960 Sample preparation
- 17970 Sample preparation for X-ray fluorescence analysis
- 17980 Sample preparation for OES and XRF (X-ray testing)
- 17990 Sample preparation machines
- 18000 Spectrometer sample preparation with remelting equipment
- 18010 Punching tools for samples

23.02. Analytical equipment

- 18020 Analytical instruments
- 18022 Devices for inline concentration measurement of liquids
- 18025 Analyzers for oxygen measurement

- 18027 Automated analyzers for process control and wastewater management
- 18030 Automation equipment for analysis and laboratory
- 18040 Gas analyzers
- 18048 Laser induced fluorescence
- 18050 Laser plasma spectrometer
- 18059 Mass spectrometers
- 18060 Conductivity and pH measuring instruments
- 18070 Oil-in-water monitoring in the laboratory and in industry
- 18080 Optical emission spectrometers
- 18090 O2 analyzers
- 18100 Plasma spectrometers
- 18105 X-ray diffractometers
- 18110 X-ray fluorescence spectrometer
- 18120 X-ray fluorescence spectrometers, portable
- 18130 Oxygen probes
- 18138 Heavy metal analysis in water, laboratory, field, process and online
- 18140 Nitrogen analyzer system for direct determination
- 18150 Nitrogen probes
- 18160 Hydrogen analysis system for direct determination
- 18170 Hydrogen probes
- 18180 Accessories for analytical technology

23.03. Laboratory equipment, general

- 18190 Analytical standards
- 18200 Analytical reference material
- 18202 Equipment for sample preparation for OES and XRF (X-ray testing)
- 18210 Calibration samples
- 18220 Annealing boxes
- 18230 Laboratory furnaces
- 18240 Laboratory equipment
- 18250 Laboratory automation
- 18260 Shuttles
- 18264 Shuttles and HF crucibles for C+S determination
- 18270 Spectral samples
- 18280 Crucibles

23.04. Metallography

- 18290 Services
- 18300 Metallography equipment
- 18310 Metallographic laboratories
- 18320 Metallographic testing

24 Environmental protection and disposal

- 18330 Consulting and measurement
- 18340 Engineering and technical assistance

24.01. Dedusting and gas cleaning

- 18342 Exhaust gas technology
- 18348 Oxygen sensors for exhaust gas
- 18350 Exhaust systems
- 18360 Exhaust gas cooling systems
- 18362 Exhaust gas cooling with heat recovery
- 18370 Exhaust gas cleaning systems

- 18375 Secondary exhaust gas cleaning systems
- 18376 Sintered exhaust gas cleaning systems
- 18377 Desulfurization of sinter flue gases
- 18378 Exhaust gas cleaning for pellet plants
- 18380 Waste heat boiler
- 18390 Aerosol separation
- 18400 Treatment of dusts from steel mills and foundries
- 18410 Electrostatic precipitator
- 18420 Dedusting and gas cleaning
- 18430 Dedusting plants and accessories, general
- 18440 Dedusting filters and plants (cassette, cartridge, round, bag, pocket filters, etc.)
- 18450 Denitrification plants
- 18460 Denitrification catalysts (DENOX)
- 18470 Fine dust removal for sinter plants
- 18480 Filter media
- 18490 Gas recovery plants
- 18500 Fabric filters
- 18510 Casting shop dedusting
- 18515 Blast furnace exhaust gas cleaning
- 18520 Hot gas filtration
- 18530 Industrial vacuum cleaners
- 18535 Catalytic plants
- 18536 Catalyst service
- 18540 Compact air cleaner
- 18550 Laser Clean Box
- 18560 Air filters (also in-line filters)
- 18570 Multicyclones and cyclones
- 18580 Afterburning, catalytic
- 18590 Afterburning, thermal
- 18600 Wet dust collectors
- 18608 Wet dedusting systems
- 18610 Wet fine dust removal for sinter plants
- 18615 Wet electrostatic precipitators
- 18620 Wet cleaning plants
- 18630 Flue gas desulfurization for boiler and sinter plants
- 18640 Flue gas cleaning plants for waste and hazardous waste incinerators
- 18650 Dust collectors
- 18660 Dust measuring devices
- 18670 Dust recovery plants
- 18690 Thermal exhaust air purification
- 18693 Dry exhaust gas cleaning plants
- 18700 Dry dedusting plants (also rotary flow dedusters)
- 18710 Dry cleaning plants
- 18720 Venturi dust collectors
- 18728 Central exhaust systems
- 18730 Central dust extraction plants

24.02. Waste water treatment

- 18740 Waste water plants, grease separators, chemical pumps
- 18750 Waste water treatment
- 18755 Waste water treatment, thermal
- 18756 Wastewater treatment for wastewater containing oil and grease
- 18760 Wastewater treatment plants
- 18770 Chemical water treatment
- 18774 Evaporation plants
- 18790 Wastewater treatment plants
- 18800 Recirculation systems
- 18802 Recirculating water treatment
- 18810 Solvent recovery plants
- 18820 Neutralization and detoxification plants

- 18830 Sludge dewatering, mobile
- 18840 Sludge dewatering, stationary
- 18842 Water management

24.03. Regeneration plants

- 18870 Regeneration plants for pickling solutions
- 18880 Acid resistant collection cups and wall coatings with DIBt test mark
- 18890 Sand regeneration plants

24.04. Recycling and waste disposal

- 18900 Exhaust air purification
- 18910 Remediation of contaminated sites
- 18920 Plants for the recycling of raw materials (dusts)
- 18921 Plants for the recycling of residual materials
- 18922 Car recycling plants
- 18923 Electric arc dust recycling
- 18925 Biological exhaust air treatment
- 18930 Soil and groundwater remediation
- 18940 Flaring plants, thermal afterburning
- 18970 Injection plants for filter dust
- 18975 Injection plants for alloy and residual materials using oxygen burners
- 18980 Storage of substances hazardous to water
- 18990 Oil and grease removers
- 18997 Radioactive substances
- 19000 Residue-free vibratory grinding
- 19005 Slag processing (slag transport and recycling)
- 19009 Chimney construction
- 19010 Chimneys (also sheet metal chimneys)
- 19020 Separation of non-ferrous metals
- 19045 Plants for preparation and recycling of metallurgical residues
- 19050 Other disposal plants
- 19060 Recycling of residual materials (ashes, slags, dusts, sands)
- 19070 Rolling mill slag de-zincification
- 19072 Dezincification of metallurgical dusts
- 19080 Recovery of recyclable materials
- 19090 Fluidized-bed drying of steel mill sludges

24.05. Components

- 19110 Separators (gasoline, benzene, oil, water)
- 19114 Aerators and agitators
- 19120 Emulsion splitting plants
- 19130 Injection plants for processed, oil-containing mill scale sludges
- 19140 Injection plants for Carbo Fer
- 19150 Injection plants for PE granules
- 19160 Heat exchangers

24.06. Operating materials

- 19170 Activated carbon
- 19180 Lignite coke
- 19190 Oil binder
- 19200 Lubricants

24.07. Services

- 19210 Exhaust gas measurements
- 19220 Chemical and mineralogical analysis
- 19230 Emission measurements
- 19232 Simulation software for exhaust gas measurement with design and optimization of exhaust systems

25 Occupational safety and ergonomics

- 25.01. Occupational safety**
- 19240 Occupational safety clothing
- 19260 Respiratory protection masks
- 19263 Fire blankets for welding work made of textile fabric
- 19266 Fire blankets and containers
- 19270 Gas detectors
- 19280 Heat protective clothing
- 19285 High temperature resistant and fireproof textile products
- 19289 Protective glass
- 19290 Industrial protective glass
- 19300 Light curtains for accident prevention and other applications
- 19305 Soldering protection mats made of textile fabric
- 19310 Furnace sight glass Neotherm®
- 19320 Safety edges
- 19330 Safety mats
- 19340 Welding protection glass Athermal®
- 19350 Welding accessories
- 19360 Dust measuring devices

- 25.02. Noise protection devices**
- 19368 Hearing protection
- 19370 Noise reduction
- 19380 Industrial noise protection
- 19390 Noise protection devices
- 19400 Noise monitoring
- 19410 Level recorder
- 19420 Sound insulation
- 19430 Sound level meter
- 19432 Sound insulation

26 Other products

- 19440 Aluminium and zinc slug production

- 26.01. Foundry products**
- 19450 Stainless steel mold casting
- 19460 Stainless steel shell mold casting
- 19470 Stainless steel centrifugal casting
- 19490 Investment casting by the lost wax process
- 19500 Cast iron with spheroidal graphite (ductile iron)
- 19510 Cast iron with lamellar graphite (gray cast iron)
- 19520 Cast iron shape casting
- 19530 Continuous cast iron
- 19540 Chilled cast iron
- 19550 Heat resistant cast iron
- 19560 Gravity die casting
- 19570 Copper and copper alloy castings
- 19580 Light metal castings
- 19590 Machine mold casting
- 19610 Acid resistant castings
- 19630 Centrifugal casting
- 19640 Heavy metal casting
- 19660 Steel casting
- 19670 Wear-resistant casting

27 Consulting, planning and services

- 19695 Hot tapping under pressure
- 19700 Fittings service
- 19710 Training and further education of welding personnel
- 19715 Consulting, planning and services
- 19720 Consulting services
- 19721 Consulting for optimization of weighing systems
- 19730 Consulting service
- 19731 Procurement, eProcurement
- 19734 blended learning
- 19740 Services, quality assurance
- 19750 Emission measurements
- 19760 Energy consulting
- 19770 Energy saving
- 19780 Energy service (optimization, recovery, supply)
- 19790 Decoating
- 19792 Spare parts for commissioning
- 19794 Commissioning
- 19810 Engineering services (also commissioning of metallurgical plants as well as conveyor and drive technology plants)
- 19815 Engineering problem solving
- 19820 Maintenance organization
- 19822 Cooling and boiler water treatment
- 19824 Lean management
- 19825 Leak sealing under operating pressure
- 19830 Logistics consulting
- 19832 Logistics services, steel logistics
- 19840 Contract annealing
- 19850 Contract annealing (own mobile annealing facilities)
- 19860 Management consulting
- 19875 On-site machining (milling, drilling, turning, grinding, etc.)
- 19880 Assembly and maintenance
- 19890 Marketing services
- 19892 Offline Maintenance
- 19893 Online Maintenance
- 19895 Quality management consulting
- 19900 Experts
- 19910 Cutting and welding consulting
- 19920 Welding research and education
- 19930 Simulation studies and software
- 19935 Software for metalworking
- 19940 Supplier of spare parts, equipment and accessories for the steel industry, general
- 19950 Radiation
- 19952 Radiation protection
- 19955 supply chain management
- 19960 Digitalization consulting
- 19970 Software solutions for digitalization
- 19980 Digitization analysis
- 19990 Technical translations and documentation
- 20000 Training and commissioning of metallurgical plants
- 20005 Management consulting
- 20010 Leasing of electronic measuring equipment, data technology and computers
- 20015 Continuing education
- 20016 Continuing education - refractory
- 20020 Certifications

28 Steel in civil engineering

- 28.01. Software for building and construction**
- 20050 Cad software

- 28.02. Steel in building construction**
- 20058 Structural steel
- 20070 Hall gates
- 20086 Pipelines

- 28.03. Steel in civil engineering**
- 20100 Offshore technology
- 20106 Tubes
- 20108 Micropiles
- 20110 Anchorages
- 20112 Sheet piling

30 Service concerning steel materials

- 20135 Processing services

- 30.01. Joining**
- 20178 Soldering

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04 Steelmaking

04.10 Steel works materials

2735 EBT taphole plugging compound



WEEBOTEC GmbH
 Lingenstr. 12-14
 45472 Mülheim an der Ruhr, Germany
 ☎ +49 208 49538-700
 📠 +49 208 49538-799
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The next issue of STAHL + TECHNIK in German will be out in April and includes the following topics:

STEEL TECHNOLOGY

New generation of slag detection systems in high-grade steel production

AMEPA has successfully commissioned the new digital measuring system ESD 300 for electromagnetic slag detection at a continuous casting plant of Salzgitter Flachstahl. It detects slowly accumulating slag in the casting channel and automatically closes the ladle slide gate.

Green lime for green steel production

One of the leading European lime manufacturers Lhoist Germany is aiming to avoid around one million tonnes of CO₂ in just a few years, thus supporting the production of green steel with climate-neutral lime. Together with the industrial gases company Air Liquide, Lhoist is working on plans for a large-scale industrial plant to capture the CO₂ resulting from lime production. For German steel maker thyssenkrupp Steel, green lime is another cornerstone in the transition of Europe's largest steel site in Duisburg. The State Minister for Economic Affairs and Climate Protection, Mona Neubaur, supports the project.

STEEL DISTRIBUTION

Saving money, memory and CO₂ with an intelligent archiving concept

Klöckner & Co. relies on a Group-wide standard archiving solution and the migration of more than 90 million documents from OpenText to the cloud. After the successful trial run in the Switzerland branch, the steel and metal distributor has now decided on a group-wide rollout.

STEEL PROCESSING

Ultra-fine-grained, high-strength and tough steel thanks to XTP®

When commodity steels need to have special properties, expensive alloying materials and special heat treatment processes are usually used. Steeltec AG has developed an innovative alternative to this. "Extreme Performance Technology (XTP®)" produces an extra-fine and tough quality steel thanks to controlled thermomechanical process control, which in turn make additional alloys and special treatments obsolete.

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Contact: Markus Winterhalter, Tel. +49 211 1591-142,
E-mail: markus.winterhalter@dvs-media.info

Publishing House

DVS Media GmbH
PO Box 10 19 65, 40010 Düsseldorf, Germany
Aachener Straße 172, 40223 Düsseldorf, Germany
Phone +49 211 1591-0
Fax +49 211 1591-200
E-mail media@dvs-media.info
www.dvs-media.eu · www.home-of-steel.de

Management: Dirk Sieben

Editorial Team

Dipl.-Ing. Arnt Hannewald (responsible)
Phone +49 211 1591-232
E-mail arnt.hannewald@dvs-media.info

Angela Layendecker, Marie-Andrée Brenner

Advertising

Markus Winterhalter (responsible)
Phone +49 211 1591-142
E-mail markus.winterhalter@dvs-media.info

Katrin Kuchler
Phone +49 211 1591-146
E-mail katrin.kuechler@dvs-media.info

Christian Lang
Phone +49 211 1591-291
E-mail christian.lang@dvs-media.info

Henning Schneider
Phone +49 211 1591-223
Mobile +49 151 74 41 46 57
E-mail henning.schneider@dvs-media.info

Claudia Wolff
Phone +49 211 1591-224
Mobile +49 173 66 32 808
E-mail claudia.wolff@dvs-media.info

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Reader Service

DVS Media GmbH
Phone +49 6123 92 38-242
Fax +49 6123 92 38-244
E-mail dvsmedia@vuser-service.de

Graphic Design

Fronz Daten Service GmbH & Co. KG
Marktweg 42
47608 Geldern, Germany

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