

# STEEL+ TECHNOLOGY

THE TECHNICAL MAGAZINE FOR IRON AND STEEL PROFESSIONALS AROUND THE WORLD

Voestalpine  
to transform  
to electric  
steelmaking  
in Linz and  
Donawitz



Photo: Voestalpine

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See article on page 20

## INTERVIEW

Midrex President K.C. Woody on the prospects for direct reduction iron & steel making

## SPECIAL

METEC & THERMPROCESS trade fairs as strong platform for future-oriented metallurgy

## STEEL TECHNOLOGY

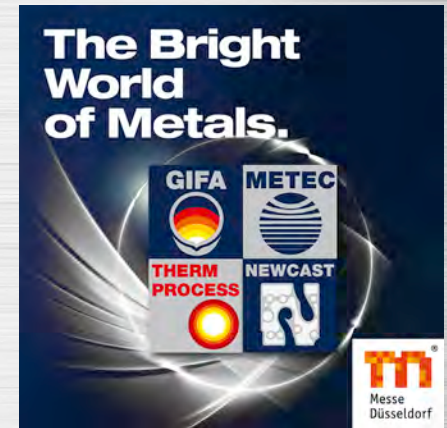
The transformation marathon: technological pathways towards green steel

## STEEL PROCESSING

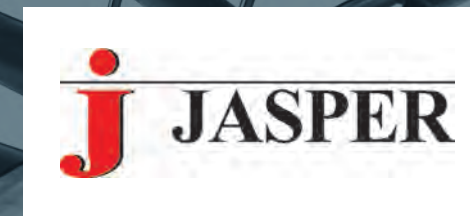
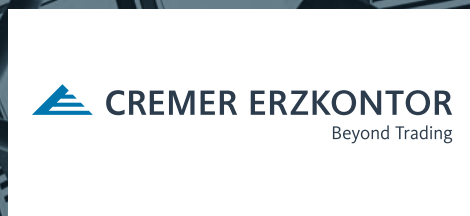
Quality assurance solutions meeting the demands of steel service centres



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## METEC and THERMPROCESS ahead

In June, Düsseldorf will once again become the centre of the international foundry and metallurgy industry. Then, for five days, the world's leading trade fair quartet – GIFA, METEC, THERMPROCESS and NEWCAST – which takes place every four years, will cover the entire spectrum of foundry technology, cast products, metallurgy and thermoprocessing technology. Current challenges are driving digitisation in the metal industry and its search for sustainable and future-oriented solutions. It goes without saying that we provide a comprehensive preview of this mega-event in this issue, starting on page 39. Many exhibitors have contributed information about the innovations they are showing in Düsseldorf.

It is not just because of the trade fair that there is so much interesting news from so many companies. K.C. Woody, the newly appointed President of Midrex Technologies, Inc. gave us an interview about the prospects for iron and steel production using direct reduction technologies. Then, Austria's voestalpine begins to implement its transformation plan for its two integrated iron and steel works in Linz and Donawitz. The company will build electric arc furnaces to substitute the blast furnace and basic oxygen furnace technologies step by step. The necessary preparatory work is already in full swing.

While we often report on how individual companies are redesigning their production to be more climate-friendly, we asked the SMS group for an overview of the various technical options available. The routes for decarbonization in ironmaking and steelmaking – the pathways towards green steel are explained in an article starting on page 55.

In the field of steel processing Danieli has given an update on Rotoforge technology as an alternative solution to the production of high-quality material via of the open-die forging route (page 70). Combining the advantages of rolling and forging processes, the heavy-duty Rotoforge delivers large-size SBQ products with perfect internal soundness similar to the forged blooms, but at a higher productivity.

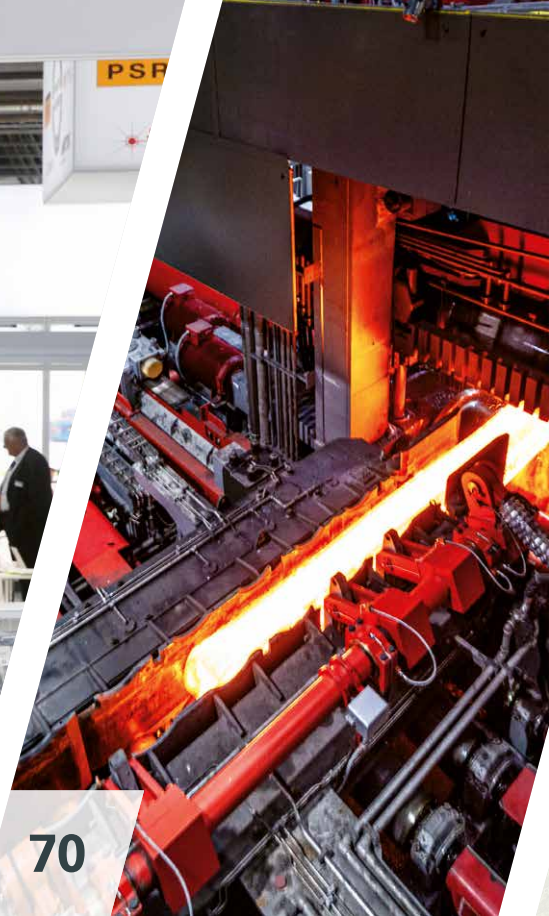
In this issue you will find some more articles on advanced steel grades and their applications, addressing steel distributors, steel fabricators and consumers alike. The common theme is that the market for green steel is expected to grow in the future. The demand for green steel is spreading to more and more end markets. This is one of the topics that will also be discussed at HÜTTENTAG 2023 – the annual technology event for steel in the heart of Europe, which will take place in Essen on 16 November. Save the date and take a look at the information from the organisers.

Enjoy reading,

*Arnt Hannewald*



**Arnt Hannewald,**  
Dipl.-Ing., Editor



39

The Bright World of Metals 2023: METEC and THERMPROCESS trade fairs as a strong platform for energy-intensive metallurgy

70

■ **COMPANIES**

- 20 **Voestalpine to transform to electric steelmaking in Linz and Donawitz**
- 22 **Prospects for iron and steel production using direct reduction technology**  
Interview with K.C. Woody, President of Midrex
- 26 **Tenova opens labs for sustainable technologies**
- 28 **Climate leaders to drive decarbonisation in South Korean steel**
- 30 **A two-speed decarbonisation plan**  
ArcelorMittal's path to net zero CO<sub>2</sub> under scrutiny as plans for India contrasts with ones for EU/Canada

■ **SPECIAL**

- 39 **METEC + THERMPROCESS trade fairs as a strong platform for CO<sub>2</sub>-intensive metallurgy**

■ **STEEL TECHNOLOGY**

- 55 **Pathways towards green steel**  
The technologies for achieving climate-neutral steelmaking are available right now – ready to be implemented

58 **Infrared sensor technology for state-of-the-art off-gas analysis**

New technology has been successfully commissioned at the EAF of FERALPI STAHL in Riesa

61 **Revolutionary solution for hot slag transport**

The remotely controlled Hot Box Mover is an automatic solution for transport of liquid slag

64 **Scheduling system for steel production lines**

Nucor Steel Gallatin has integrated a management execution system at its flat steel complex

65 **Cooling conveyor technology for hot iron ore pellets, DRI and HBI**

Equipment for handling hot, abrasive and chemically reactive bulk materials is suitable as new equipment or for conversion projects

68 **Lasers analyse slab heating furnaces molecule by molecule**

At Tata Steel UK digitally fired furnaces have been equipped with an innovative laser technology

69 **Record-breaking caster to produce dia. 1,600 mm rounds**

Semi-continuous vertical caster to produce the most competitive, jumbo-sized special steel grades

70 **Rotoforged bars for the energy, automotive, nuclear and oil and gas sectors**

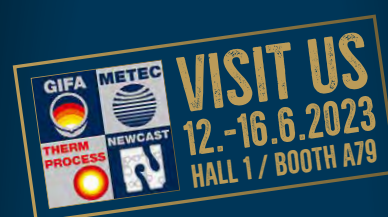
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**77** Quality assurance in steel service centres in line with processing requirement



**90** Wuppermann Austria expands its manufacturing capabilities and production capacities

### ■ STEEL DISTRIBUTION

- 76 Perfectly flat sheets free of internal stresses**  
ArcelorMittal has incorporated new stretch-levelling equipment in its Kraków Steel Service Centre
- 78 Emissions reduction certificates help reducing the carbon footprint**  
With so-called Voluntary Carbon Credits companies can offset emissions along their own value chain

### ■ STEEL PROCESSING

- 83 Minister visits Andernach & Bleck in Germany**  
The Minister met representatives of the steel company to discuss the current economic challenges facing the steel sector
- 84 Quality assurance solutions for service centres**  
Steel service centres have to master challenges because their most important customers, the automotive companies, are facing a paradigm shift
- 90 Wuppermann Austria commissions new roll forming line**  
Production capacity has been expanded particularly to meet the demand from the photovoltaic industry
- 92 Performance steel for construction and transportation equipment**  
High-strength structural steel helps manufacturers build stronger, lighter and sustainable equipment

# ADVERTISERS' INDEX

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AUMUND Fördertechnik GmbH	1, 35
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Böllinghaus Steel GmbH	77
CREMER ERZKONTOR GmbH & Co. KG	1, 17
cunova GmbH	1, 9
DANGO & DIENENTHAL Maschinenbau GmbH	41
Danieli & C. Officine Meccaniche SpA	18, 19
Danieli Germany GmbH	1, 124
DELTA France	36
DVS Media GmbH	26, 27
EMG Automation GmbH	1, 29
GLAMA Maschinenbau GmbH	1, 11
GÖCKE GmbH & Co. KG	81
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Jato-Düsenbau AG	10
KELLER HCW GmbH	51
Kiro-Nathaus GmbH	63
Friedrich Kocks GmbH & Co. KG	1,5
LOI Thermprocess GmbH	1, 39
M.A.T. Malmedie Antriebstechnik GmbH	43
Messe Düsseldorf GmbH	13
Micro-Epsilon Messtechnik GmbH & Co. KG	37
Midrex Technologies Inc.	123
NoKra Optische Prüftechnik und Automation GmbH	53
SMS group GmbH	2
Stein Injection Technology GmbH	75
TEMA Technologie Marketing AG	79
TML Technik GmbH	23
VELCO GmbH	82
Ventilatorenfabrik Oelde GmbH	31
Wonjin Worldwide Co., Ltd.	33
Friedrich Vollmer Feinmeßgerät	54
WS Wärmeprozessstechnik GmbH	1, 15
Zumbach Electronic AG	67

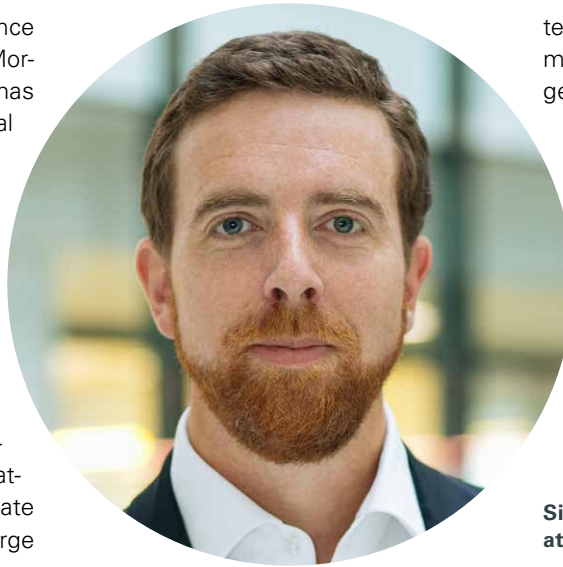


## CRU names new Head of Base Metals

Global commodities business intelligence company, CRU, has appointed Simon Morris as Head of Base Metals. Morris has over 20 years' experience in the natural resources sector spanning all parts of the value chain.

Simon, who is based in the United Kingdom, will bring his expertise and considerable industry experience to lead a global team of analysts working to support CRU's customers understand and navigate the highly-complex world of base metals.

Before joining CRU, he held positions at Rio Tinto and Shell in senior strategy, investment analysis and corporate relations roles. He has been leading large



teams for over a decade, including a base metals division for a B2B market intelligence company. Most recently, Simon was Chief of Staff and headed the strategy and corporate affairs departments at a commodity trading firm.

■ CRU

**Simon Morris, new Head of Base Metals at CRU** (Picture: CRU)

## Esmark announces passing of international iron and steel veteran Hans Joachim Schmidt

Esmark announced with sadness the passing of Hans Joachim Schmidt, father of Uwe T. Schmidt, Esmark founding investor and long-time member of the Esmark board of directors.

The Schmidt family played an integral role in establishing Esmark's leading position in the company's steel and tin opera-

tions. Hans Joachim Schmidt, who passed away on February 19, 2023, at the age of 90, was an admired leader and internationally recognized business executive serving the international iron and steel industry for 45 years.

Hans Joachim Schmidt served 37 years with the Thyssen Group (now thyssen-

krupp), including the role of President and Chief Executive Officer of Thyssen Canada Ltd and Member of the Executive Board of Thyssen Inc., NA.

■ Esmark

## New dual leadership at Slovenian Aichelin subsidiary



After Hugo Bosio, founder and long-time CEO of Slovenian industrial furnaces manufacture BOSIO d.o.o., a subsidiary of Aichelin, turned to new challenges, the company management has been reorganized.

As a new addition to the management team of the Aichelin group, Marko Klinc will be in charge of production at BOSIO as Managing Director. At the same time, he will be the sole managing director of Aichelin Assembly Center Europe (ACE), which is located at the same site in Slovenia. ACE recently launched the first expansion stage of a modern production facility for heat treatment plants in Europe in the Slovenian city of Celje.

Dipl.-Ing. Marko Klinc acquired extensive management expertise at the Slovenian industrial group Gorenje. At BOSIO d.o.o., he will be assisted by Dipl.-Ing. Michael Reisner as an additional managing director, who will be primarily responsible for the new installations business. Reisner has been and will continue to be Managing Director of Austrian heat treatment plant manufacturer Aichelin Ges.m.b.H. in Mödling.

■ Aichelin

**Michael Reisner (left) and Marko Klinc form the new dual leadership at Slovenian Aichelin subsidiary BOSIO d.o.o.** (Picture: Aichelin Holding GmbH)



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## Midrex names K.C. Woody President and COO



**K.C. Woody will succeed Stephen Montague as President of Midrex** (Picture: Midrex)

Midrex has announced that Stephen Montague, current President and Chief Executive Officer (CEO) will retire in April 2024 after more than 35 years at the company.

K.C. Woody will be promoted to president effective immediately and maintain his current role as chief operating officer (COO). Stephen Montague will remain as CEO until his retirement and then continue to serve on the Board of Directors.

Woody joined Midrex in 2010 and has served in a variety of commercial roles including the first Managing Director of Midrex India Private Limited and Vice President-Commercial of Midrex Technologies, Inc.. In 2020, he was named Chief Operating Officer (COO), leading all the commercial and operations activities for the company. Woody is a graduate of the U.S. Military Academy at West Point and served on active duty as an officer in the US Army prior to Midrex.

■ *Midrex Technologies, Inc.*

## CMC appoints new President

Commercial Metals Company (CMC) has appointed Peter R. Matt as President, succeeding Barbara R. Smith who will remain chairperson and Chief Executive Officer of the company.

Peter R. Matt is a seasoned global business leader with significant experience across a range of manufacturing companies in metals and metals-related industries.

Since January 2017, he has served as Executive Vice President and Chief Financial Officer of global aluminium fabricator Constellium SE. Matt will continue to serve on the board of directors of the company, which he joined in June 2020.

■ *Commercial Metals Company*

## Appointment of President and CEO of Fabral

Flack Global Metals (FGM) has announced that Dennis Merino has been appointed President and Chief Executive Officer of the newly acquired Fabral Metal and Wall Roofing Systems.

Dennis Merino possesses over 30 years of experience in the building products sector. His appointment is Merino's second tenure with Fabral. He previously held the role of Vice President and General Manager.

Fabral is an independent organization and the first venture of FGM's new direct equity investment platform, Flack Manufacturing Investments (FMI), centered on steel-consuming OEMs.



**Dennis Merino, new President and CEO of Fabral** (Picture: Fabral)

■ *Fabral*



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## EUROPE – FINLAND

### Outokumpu and Fortum partner to explore potential of nuclear technology in decarbonization

**Stainless steel producer Outokumpu and Nordic energy company Fortum have signed a Memorandum of Understanding to explore the decarbonization of Outokumpu's steel manufacturing operations with emerging nuclear technology – Small Modular Reactors (SMR).**

The agreement initiates a long-term process with the aim to access potential construction of an SMR in Finland. In the first phase, the goal is to identify potential business models and technical solutions for further development. Any potential investment decisions will be made at a later stage.

Outokumpu has committed to the Science-Based Targets initiative's 1.5°C climate target. Maintaining and increasing the share of low-carbon energy is important to achieving the company's ambitious sustainability goals. Both Outokumpu and Fortum play a key role in ensuring energy efficiency, emission reduction and competitiveness in Finland. One possible option for the location would be the Tornio region in Finland, where Outokumpu's largest mill is situated.

"Outokumpu is Finland's largest electricity buyer. In order for the steel industry to remain competitive in Finland, we need to have a sufficient amount of low-carbon and cost-effective energy,"

says Heikki Malinen, President and CEO, Outokumpu.

**|** *Outokumpu/Fortum*



**Outokumpu's largest steelmaking mill is situated in Tornio, Finland** (Photo: Outokumpu)

## EUROPE – FRANCE

### Schaeffler acquires ECO-Adapt

**Automotive and industrial supplier Schaeffler has acquired 100% of the shares of ECO-Adapt SAS, providers of innovative solutions for condition monitoring based on electrical signal analysis, and systems for energy consumption optimization.**

The acquisition expands Schaeffler's portfolio of lifetime solutions and strengthens its position in the field of digitally-based predictive maintenance. With ECO-Adapt, Schaeffler offers a new range of products covering the optimization of energy consumption during machine operation. The ECO-Adapt product line also provides multi-circuit meters to facilitate industrial sub-metering, with a full cloud-based solution, including customized analytics and dashboards.

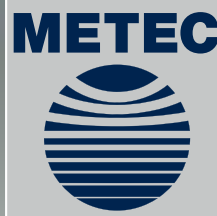
Established in 2012 and headquartered in Paris, France, ECO-Adapt combines smart hardware and data analytics to provide solutions for the analysis and optimization of energy consumption and predictive maintenance of electric rotating machines.

Schaeffler's OPTIME Condition Monitoring for predictive maintenance based on signal analysis of vibration and temperature data can now be complemented by maintenance information on the basis of electrical signal analysis, providing additional security against potential failures of electrical components. With this holistic approach to predictive maintenance, operator can tackle both mechanical and electrical issues.

**|** *Schaeffler*



**ECO-Adapt hardware and data analytics for optimized energy consumption and predictive maintenance of electric rotating machines.** (Photo: Eco-Adapt)



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## EUROPE – GERMANY

### Possehl Erzkontor renamed Cremer Erzkontor

**In parallel with then name change the company opened an office in India. This is the fourth subsidiary in Asia.**

Following the shareholders' decision the former Possehl Erzkontor GmbH & Co. KG has changed its name to Cremer Erzkontor GmbH & Co. KG. This step is related to the company's transformation strategy launched three years ago. With the name change, Erzkontor draws closer to the German family company Cremer, which acquired the shares of the Lübeck-based raw materials trader in 2014. "This renaming creates transparency and the basis for continued shared growth. In the coming years we will benefit even more from each other with a coordinated strategy", said Dr. Ullrich Wegner, CEO of Peter Cremer Holding, Hamburg, Germany.

With the renaming the over 100 years history of Possehl Erzkontor now enters a new chapter. Nils Fleig, Director of Cremer Erzkontor: "The name change is a statement. The road we're on takes us from being purely a raw materials trader to managing the supply of raw materials for our customers. In addition to logistics services, this includes the further processing and recycling of these materials in our own facilities. The Cremer name stands not just for international trade and logistics, but also for the refinement of products and for an extraordinary worldwide network; it's a perfect fit."

Cremer Erzkontor recently opened a new Asian subsidiary in Chennai, India with Ananthanarayana Nonavinakere being the regional director. After Hong Kong, Dalian and Beijing, Chennai is now the fourth business hub of Cremer Erzkontor in Asia, underlining the important role that Asia plays in international raw material supply. "In addition to expanding the trading business locally, the office will help with accessing new raw materials and sources", says Nicol Tomaschewski, Head of Region Asia at Cremer Erzkontor.

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## EUROPE – GERMANY

### Stahlwerk Annahütte to instal new walking-beam furnace

**Stahlwerk Annahütte (SAH) has selected Danieli Centro Combustion technology and equipment for its new walking-beam reheating furnace to be installed at its Hammerau location.**

The order is part of a broader modernization strategy pursued by SAH. The new 80-t/h furnace will ensure perfect billet reheating with excellent temperature uniformity. The combustion system will include Danieli-pat-

ented Hydromab hydrogen-ready burners. The Danieli scope of supply will also include furnace power distribution, automation, human machine interfaces, and L1 and L2 process controls with mathematical models for the optimization of the heating process. Upstream and downstream material handling equipment, hydraulic systems, and combustion technologies including the combustion air-preheating and the exhaust system will complete the installation. The new reheating furnace is scheduled to start up by September 2024.

SAH specializes in the production of high-quality special steel bars and thread bars used in the technical engineering sector as well as in the automotive and tool industries. The new furnace and combustion equipment will reduce energy consumption and the carbon footprint, and minimize NO<sub>x</sub> emissions.



SAH and Danieli representatives after signing the contract for the new billet reheating furnace (Photo: Danieli)

**| Danieli**

## EUROPE – GERMANY

### thyssenkrupp to build new annealing and isolating line

**thyssenkrupp Steel is going to build a new annealing and isolating line for the production of thin-gauge electrical steel strip at its Bochum site. The line will be supplied by SMS group and is scheduled for completion by 2024.**

demands and significantly enhance the site's capabilities and capacities for non-grain-oriented electrical steel. During the annealing process, the microstructure of the cold-rolled strip will be recrystallized. Subsequently, the strip will be pro-

vided with an isolating layer that will enhance the efficiency of the motors manufactured from the electric strip.

**| thyssenkrupp/SMS group**

The modern and energy-efficient unit will be capable of producing electrical steel strips between 700 and 1,350 mm wide and 0.2 to 1.0 mm thick. The strips' homogeneous mechanical and magnetic properties will meet the requirements of highly efficient motors used in electric vehicles. With this goal in mind, the plant will produce up to 218,000 t/year of non-grain-oriented electrical steel in the future. The investment amounts to about 150 million euros.

In the coming years, the Bochum site will be expanded into a center of excellence for electric mobility. The trend in electric mobility is moving toward increasingly demanding grades. The new annealing and isolating line will meet these



Foundation stone laying for the new annealing and isolating line at thyssenkrupp in Bochum (Photo: thyssenkrupp/GIL)

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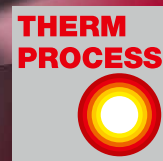
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## EUROPE – SWEDEN

### Outokumpu divests remaining Long Products operations

**Outokumpu has signed an agreement to sell its operations in Degerfors and Storfors to Cogne Acciai Speciali.**

The majority of Outokumpu's Long Products business had already been divested to Italian Marcegaglia earlier this year. Degerfors and Storfors in Sweden were not part of the deal and continued their operations as part of the group, while Outokumpu evaluated different options for the future of the units.

"Our priority has been to find a buyer also for the remaining Long Products operations in Degerfors and Storfors. We are pleased that in Cogne Acciai Speciali we have found a responsible new owner for these operations as well. At the same time, the divestment is a further natural step for Outokumpu in line with our strategy to focus purely on our core business, stainless steel flat products and ferrochrome," says Matti Louhija, Head of M&A at Outokumpu.

The transaction will be carried out as a share sale. It is still subject to customary closing conditions and regulatory approvals by the competition authorities. Outokumpu's other operations in Degerfors are not affected by the divestment.

■ *Outokumpu*

## EUROPE – UNITED KINGDOM

### Tata Steel upgrades Corby steelworks

**Tata Steel is investing in state-of-the-art electric induction furnaces from Inductotherm Heating and Welding Ltd for a tube mill upgrade in Corby.**

Installation of the new furnaces is the first part of Tata Steel's extensive plans to make the Corby site CO<sub>2</sub>-neutral. The new equipment will reduce emissions from one

of Tata Steel's tube mills in Corby by at least 2,000 t of CO<sub>2</sub> a year.

The stretch reduction mill (SR2) takes 169 mm diameter steel tubes and heats them to around 1,100°C before they are stretched into hollow sections as small as 40 mm in diameter with wall thicknesses as thin as 3.2 mm. The new induction furnaces will replace the original ones that first came into operation in 1980. Since then the mill has produced around 2.5 million t. The improved efficiency of the new electric furnaces means less pre-heating from the gas-fired furnaces and therefore fewer associated emissions.

The existing units will be replaced with twelve upgraded Inductotherm induction heating coil assemblies along with associated electrical infrastructure, cooling systems and process control gear. The installation work will be carried out in a two-week period at the end of October 2023.

■ *Tata Steel Europe*



Tata Steel is to upgrade the electric induction furnaces in the stretch reduction mill at its Corby site (Photo: Tata Steel)

## EUROPE – UNITED KINGDOM

### Tata Steel invests in paint line upgrade at Shotton Works

**Tata Steel is upgrading the two Colorcoat® paint lines at its Shotton Works in Deeside, North Wales. The new line equipment will be provided and installed by KCS Herr Voss UK.**

The replacement and upgrading of the paint coater heads and control systems with the latest technology will further improve quality, reduce paint use by 650,000 l/year and enable integration with on-line measurement technologies.

Coater heads are fundamental to the Colorcoat® production process, being used to apply paint to the steel strip substrate. Upgrading them delivers greater control of the paint application process by improving how the paint is transferred onto the strip. The current coater heads rely on manual adjustments to set the paint thickness, whereas the new heads incorporate a servo motor control, which will provide much greater accuracy and

repeatability, and safer hands-free operations.

Commissioning of the new finish coater heads on No.1 paint line has already been completed, with work on the second

line expected to be completed in June 2023.

■ *Tata Steel Europe*



**New coater head for Tata Steel's Shotton works** (Photo: Tata Steel)

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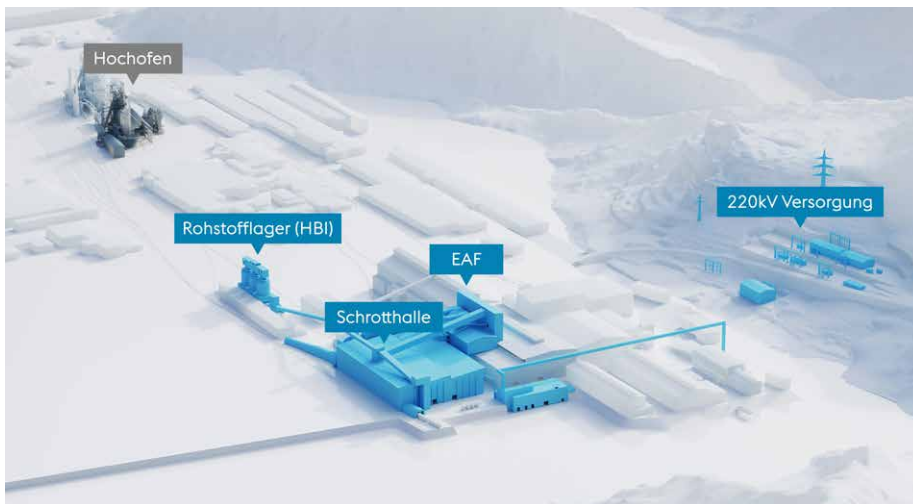
With the order placed by CMC Steel for its fourth new, MIDA QLP hybrid-ready minimill, the Danieli scorecard hits 25 plants for long-product endless casting-rolling, out of 110 total minimills.



## SUPERVISORY BOARD APPROVES PLANS

# voestalpine to transform to electric steelmaking in Linz and Donawitz

Austrian steelmaker voestalpine is spending around 1.5 billion euros into constructing two electric arc furnaces at the integrated iron and steel works in Linz and Donawitz. The decisions on technologies will be made later in 2023. Nevertheless, construction is to start already in 2024, and commissioning of the two units is scheduled to take place in 2027. The actual start of implementation depends on clarifying unresolved funding issues in Austria.



Conversion plan for the Donawitz site in 2027 (Picture: voestalpine)

One year ago, the supervisory board of voestalpine AG gave the green light to conduct the preliminary work for climate friendly steel production in Austria. This is now at an advanced level. The next approval stage has been reached.

With the decision of the supervisory board, voestalpine is continuing to steadily implement its plan to achieve the global climate goals. The necessary preparatory work is already in full swing, and construction of the two electric arc furnaces (EAF) is scheduled to start next year. This would allow the group to replace actually two blast furnaces with two EAFs by 2027, reducing its CO<sub>2</sub> emissions by up to 30%. "greentec steel is Austria's largest climate protection program. It will allow us to save five percent of Austria's entire annual CO<sub>2</sub> emissions from 2027. We need to start this year if we are to meet our target of com-

missioning the two new electric arc furnaces in Linz and Donawitz in 2027," stresses Herbert Eibensteiner, CEO of voestalpine AG. Key requirements for this next major step are sufficient availability of green electricity at competitive prices, and clarification of unresolved funding issues.

"The supervisory board has closely examined the decarbonization plan presented by the management board of voestalpine, and unanimously gave it their enthusiastic approval. This investment will secure the future of our two steel production sites in Linz and Donawitz over the long term, and with it the future of our Group," says Dr. Wolfgang Eder, chairman of the supervisory board.

### 2.5 million tons of CO<sub>2</sub>-reduced steel annually from 2027

Compared to the current two-stage LD blast furnace route ("Linz-Donawitz process") – in which hot metal is produced in the blast furnace before being processed into crude steel in the basic oxygen furnaces at the LD steel plant – an EAF powered by green electricity produces crude steel in a single step. The EAF is charged with scrap, hot metal, and HBI (hot briquetted iron), with the mix adjusted according to the quality requirements.

Voestalpine will source most of the HBI it requires from the direct reduction plant

**Greentec steel is Austria's largest climate protection program. It will allow us to save 5% of Austria's entire annual CO<sub>2</sub> emissions from 2027.**

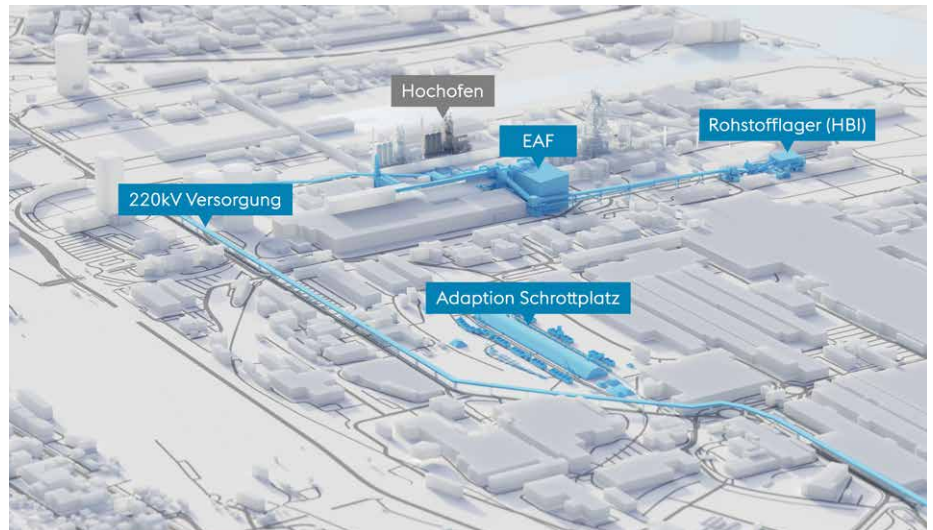
*Herbert Eibensteiner, CEO of voestalpine AG*

in Corpus Christi, Texas/USA. This facility has been majority-owned by ArcelorMittal since 2022, with voestalpine holding a 20 percent minority in the facility. "With this stake in the plant, last year we signed a long-term supply contract for 420,000 tonnes of HBI annually. Having a secure supply of HBI and scrap as raw materials is a major competitive advantage for voestalpine," says Eibensteiner.

The two electric arc furnaces will allow voestalpine to produce around 2.5 million tons of CO<sub>2</sub>-reduced steel from 2027: 1.6 million tons in Linz and 850,000 tons in Donawitz. From 2030, voestalpine plans to replace another blast furnace at each of the sites in Linz and Donawitz. Financing for the preparatory work is already covered by the approved investment sum, but the core units are still subject to approval.

### Green hydrogen as a key for CO<sub>2</sub>-neutral steel production

voestalpine is already researching into several new processes to achieve its goal of CO<sub>2</sub> neutrality by 2050, and investing in



Conversion plan for the Linz site in 2027 (Picture: voestalpine)

pilot projects which explore new pathways in steel production. These include research projects such as the H2FUTURE hydrogen pilot facility at the premises in Linz for manufacturing and using "green" hydrogen on an industrial scale, and the testing facility in Donawitz for CO<sub>2</sub>-neutral steel

production using hydrogen plasma to reduce iron ore. Further research projects are dedicated to the storage and reuse of unavoidable residual emissions.

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## INTERVIEW

# Prospects for iron and steel production using direct reduction technology

K.C. Woody, the newly appointed president of Midrex Technologies, Inc., sat down with us recently to share his insights into where the steel industry is going and the role of Midrex in decarbonizing this critical industry.

**M**idrex Technologies, Inc. (Midrex) is the world leader for direct reduction ironmaking technology and aftermarket solutions for the steel industry. As developer of the MIDREX® Process, Midrex has designed, built, and serviced direct reduced iron (DRI) plants for 50-plus years. MIDREX plants produce approximately 80% of the world's low carbon dioxide (CO<sub>2</sub>) DRI.

## **Congratulations on your appointment as President of MIDREX. What are your first goals?**

**KC Woody.** Thank you for inviting me to talk about what we are doing at Midrex to help decarbonize iron and steel production. We see direct reduction providing all steel producers – mini-mills and traditional integrated mills alike – the means to reduce CO<sub>2</sub> while sustaining their operations. We are a small team that does big work as we help transform the industry.

## **What are the biggest challenges as the steel industry seeks to decarbonize?**

**KC Woody.** The two biggest challenges, as I see them, are money and people. Financing the cost of developing the infrastructure to support a Hydrogen Economy and maintaining the financial stability of steel companies as they implement decarbonization measures is a significant hurdle.

The sheer magnitude of the investments that will be required exceeds what any single country or company can afford. Therefore, it will take government interaction and coordination across the globe to enact legislation and structure incentives

that promote cooperation and reward the companies who make these investments to decarbonize.

When we talk about decarbonization, we should not forget about the importance of people. Decarbonization will require new technologies and new ways to solve problems. People will make this happen. Midrex has solutions ready to immediately support the industry, but we must be proactive in meeting new challenges that will come from decarbonization. This will require people to think in a new and different way.

I think the combination of our past experience and the passion of our new teammates will enable us to deliver solutions to keep the industry sustainable moving forward.

## **What is the best method for decarbonizing iron & steel production?**

**KC Woody.** Decarbonizing the steel industry should be viewed in terms of both short- and long-term objectives. We view it this way because we can make meaningful reductions in CO<sub>2</sub> today even though



**K.C. Woody, President of MIDREX Technologies, Inc.**

green electricity for green hydrogen is not available and affordable right now. The short term being simple, efficiency enhancements, and increased scrap consumption, whereas the long term will involve new technologies and abundant availability of green energy and green hydrogen.

Currently, more than 70% of the world's steel is made from iron produced

I think the combination of our past experience and the passion of our new teammates will enable us to deliver solutions to keep the industry sustainable moving forward.

*K.C. Woody, President of Midrex Technologies, Charlotte, NC/USA*

in a blast furnace (BF) using coke (refined coal) as an energy source and reductant. The BF iron contains ~4.5% carbon from the coke, which provides energy to refine the iron in a basic oxygen furnace (BOF). As a result, BF/BOF emissions are in the range of 1.6-2.0 kg CO<sub>2</sub>/kg steel.

On the other hand, a natural gas-based direct reduction plant paired with a scrapped electric arc furnace (EAF) emits only 1.1-1.2 kg CO<sub>2</sub>/kg steel.

We can't lose sight of the fact that the "electrification" of the steel industry requires substantial investment in green energy. For example, an EAF that is powered through electricity from a coal-based power plant really doesn't lower emissions.

The common challenge for all Industrial decarbonization strategies is to phase out atmospheric greenhouse gas emissions without compromising the sustainability of the sector's companies. Solutions will be different depending on the location of iron and steel makers and their access to green energy. Our recently announced H2 Green Steel Project is an example of a

company that can take advantage of competitively priced green energy to build the greenest steel mill imagined.

On the other hand, we have other steel mills throughout the world that are taking steps to lower their emissions without abandoning traditional integrated facilities that likely have many more years of productive operation. We see hot briquetted iron (HBI) as a solution for these operators. One example of this is the growing number of BF operators adding HBI in the BF or to a new melter that feeds the BOF – either approach significantly lowering their CO<sub>2</sub> emissions.

The most agreed upon long-term method for dramatically reducing the steel industry's CO<sub>2</sub> footprint is the use of green hydrogen (H<sub>2</sub> from renewable energy) to produce DRI. MIDREX H<sub>2</sub>™ technology is available and will be implemented in the H2 Green Steel project.

As previously mentioned, the major challenge for implementing this solution is the availability of enough green energy to produce the large amounts of hydrogen required for direct reduction. While there

are several green hydrogen projects under development, the global availability for green hydrogen will take time and significant investment before this can become the primary route for steelmaking.

### How is Midrex helping to decarbonize iron and steel production?

**KC Woody.** The role of Midrex is to provide a reliable and flexible technology platform that can allow steelmakers to advance on the decarbonization path at their own pace. Their pace will be dictated by the availability of green energy to support the production of green hydrogen when their current equipment requires significant investment for refurbishment. We see some regions that are already able to support our MIDREX H<sub>2</sub> plant, while other areas will take more time. These regions can be supported by the MIDREX Flex™ plant, which allows the plant to run on natural gas today and transition up to 100% hydrogen in the future. Steelmakers can also consider importing green

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**H2 Green Steel wil implement MIDREX H2 technology to produce green steel in Sweden** (Picture: H2 Green Steel)

DRI to supplement scrap as the transition to electric steelmaking.

Another key aspect to consider is the lowering quality of iron oxide feeds globally. I think it is universally accepted that the quality of iron oxide feed will decrease in the future. There are MIDREX plants across the world that run on lower grades of iron oxide today. We are now working with our partners to help our clients better utilize these lower-quality iron oxides in downstream melters. Our recently announced project with thyssenkrupp is an example of this strategy.

I am very confident that Midrex is uniquely positioned to support this challenge and we have the desire, know-how, and people to lead the decarbonization of the industry and create a sustainable future for iron and steel.

**What is the availability of the hydrogen-addition (MIDREX Flex) and hydrogen-based (MIDREX H2) plant designs?**

**KC Woody.** Both MIDREX Flex and MIDREX H2 are immediately available. In fact, the first contracts have been awarded for each.

First, Midrex and Paul Wurth have been selected to supply the world’s first commercial totally green technology for H2 Green Steel in Boden, Sweden. Here,

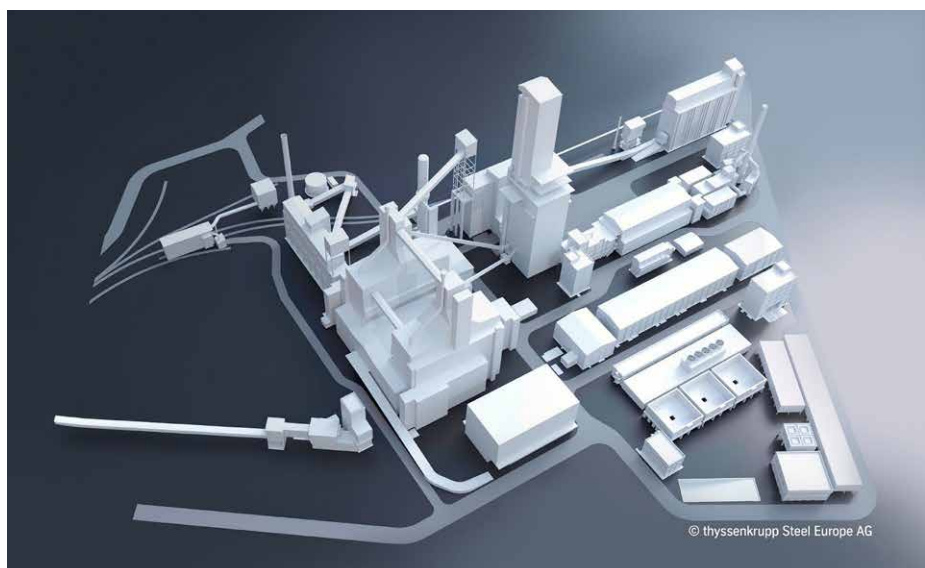
MIDREX H2 technology will be used to produce 2.1 million tons/year of HDRI and HBI. The MIDREX Plant is expected to begin production in 2025 and ramp up during 2026.

Second, Midrex and Paul Wurth will engineer, supply, and construct a 2.5 million tons/year MIDREX Flex plant for thyssenkrupp Steel Europe AG at its Duisburg, Germany, site. The plant will initially operate on reformed natural gas, which contains 50% or more H<sub>2</sub> at the inlet to the furnace, until sufficient H<sub>2</sub> is

available, at which time it will be transitioned to 100% H<sub>2</sub> operation. The plant will feed a new melter provided by the SMS Group. Start-up of the MIDREX Plant is planned for end of 2026.

**Thank you for the interview.**

*MIDREX is a registered trademark of Kobe Steel, Ltd in the US and China. MIDREX H2 and MIDREX Flex are trademarks of Kobe Steel, Ltd.*



**3D model of the future thyssenkrupp Steel complex with MIDREX Flex plant** (Picture: thyssenkrupp Steel)

## INSIGHTS IN GREEN SOLUTIONS FOR THE METALS INDUSTRY

# Tenova opens its labs for sustainable technologies

The Sustainable Heating Technologies Summit was an opportunity to delve into and share energy transition solutions for industrial furnaces in hot rolling mills and heat treatment plants



**The Sustainable Heating Technologies Summit saw an overall attendance of over 100 participants, bringing together around 40 companies from 14 countries** (Picture: Tenova)

In early spring Tenova hosted its first Sustainable Heating Technologies Summit and officially unveiled TenovaLAB, an innovative testing facility for the development of combustion systems. The event saw an overall attendance of over 100 participants, bringing together around 40 companies from 14 countries including Germany, India, and Japan.

The event was dedicated to energy transition solutions in hot rolling and heat treatment furnaces. It brought together top experts and leaders from the fields of environmental technologies, research, data science, hydrogen, and business development to delve into some of the most critical issues in the decarbonization of steel. One of the main goals of the summit was to also share insights into how to manage new investments and technologies to facilitate the green energy transition.

The conference was divided into three main parts: the company's vision for the

energy transition of the steel industry, which looked at the stepwise approach to the decarbonization of heating processes; industrial applications for improved efficiency, which outlined how different technologies can contribute to energy savings; and the laboratory journey, which focused on its automation, digital and combustion innovations.

This last segment also marked the official opening of TenovaLAB, a testing facil-

ity for the development of highly efficient and low-emission combustion systems. It aims to reproduce the same operating conditions of reheating and heat treatment furnaces, while integrating automation and digital technologies to the combustion system with the goal of reducing CO<sub>2</sub>, gas consumption and NO<sub>x</sub> emissions. Experts led visitors on guided tours, where they had a chance to see the technology in action with a live demo, as well as to explore a dedicated exhibition area.

Roberto Pancaldi, Tenova CEO, stated "The event was a huge success, and we are immensely proud of what was achieved, in particular with our innovative research facility TenovaLAB."

"It was such a pleasure to see how well-attended our first Sustainable Heating Technologies Summit was and the lively debate it generated. The official opening of TenovaLAB was a resounding success and really brought home just how crucial such a research facility is. Our intent to adopt a holistic approach to combine customers' expertise, Tenova's thermal competence, key partner solutions and specific assets at a single event certainly paid off," said Antonio Catalano, EVP Tenova Downstream Business Unit.

**I Tenova**

**I am pleased to say we are so far ahead on the road to decarbonizing the steel industry, which is essential to reach net-zero.**

*Roberto Pancaldi, CEO of Tenova*

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## INTERNATIONAL MULTI-STAKEHOLDER INDUSTRY SEMINAR

# Climate leaders to drive decarbonisation in South Korean steel

On Thursday 23 March, the Climate Group (SteelZero), ResponsibleSteel and Solutions for Our Climate (SFOC) hosted a multi-stakeholder industry seminar to discuss decarbonisation of the steel industry and pragmatic solutions to tackle climate change. The event, “Decarbonising South Korean Steel – Aligning Customer Demand and Production Pathways” was the first of its kind in South Korea.



The speakers from the event (left to right): Joojin Kim, Managing Director, Solutions for Our Climate; Esther Haerim Heo, Head of Industry, Solutions for Our Climate; Anna Song, Steel Lead, Solutions for Our Climate; Jungseok Park, Senior Manager, Corporate Citizenship Office ESG Group, POSCO; Jen Carson, Head of Industry (SteelZero and ConcreteZero), Climate Group; Shivakumar Kuppaswamy, Director- Development & Innovation, ResponsibleSteel; DoEun Kim, Head of Public Affairs – Korea, A.P Moller Maersk; Nabin Kwag, Lead Supply Chain Development Manager, Ørsted Korea; and on screen Simon Buckingham, Technical Leader for Sustainable Materials, Volvo Cars (online); Rob Jenkinson, Net Zero Program Manager, SKF Group (online) (Picture: Responsible Steel)

Industry experts and practitioners across the steel value chain gathered to share their expertise on steel decarbonisation pathways and corporate climate leadership. The event brought together corporates with investors and civil society to discuss the most effective and pragmatic routes to rapid decarbonisation, technical breakthroughs and the role companies across the steel value chain can play to support the growing sustainable steel market in South Korea.

South Korea’s steel industry is a major domestic industrial and economic sector, and a dominant player on the world stage. In 2021, South Korea ranked as the world’s 6th largest steel-producing country, with

71.4 million tons of crude steel accounting for a 3.8% share of global production. Additionally, the South Korean steel industry is an important material supplier for major related industries such as automotive, construction and shipbuilding, with a huge inter-industrial linkage.

Attendees included some of the leading players in the steel industry – both steel producers and downstream customers such as POSCO, Hyundai Steel, SeAH Steel, SeAH Besteel, Donguk Steel, Hyundai Motor Group, Schneider Electric, WSP, A.P. Moller Maersk, Ørsted and others.

Annie Heaton, CEO at ResponsibleSteel said, “In 2022, POSCO together with

ResponsibleSteel announced the certification of Pohang and Gwangyang Steelworks against the ResponsibleSteel Standard – one of the biggest steel sites in the world to achieve this accolade. This event will build on this momentum, create new partnerships and accelerate steel decarbonisation in South Korea and across the global steel value chain.”

Jen Carson, Head of Industry, Climate Group said, “All players right across the steel industry have a key role to play in accelerating decarbonisation. That’s why it’s incredibly important that steelmakers, steel consumers, policy makers, investors and civil society come together and take action

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on net zero steel. This conference is a pivotal moment in building a shared understanding of the current progress on lower emissions steel production in South Korea. And crucially, the opportunities for net zero steel production and procurement.”

Anna Song, Steel Industry Lead, SFOC said, “The steel industry around the world plays a vital role in curbing industry emissions to be on track with the 1.5 degree Paris Agreement, and Korean steel is no exception. The steel buyers on the demand side will play an especially significant role this decade because they create the business need for a rapid transition towards decarbonisation of the Korean steel industry.”

The event signalled an important exchange of ideas between key global and Korean industry players across the steel value chain. Momentum on steel decarbonisation is expected to continue building in the coming months, with the annual SteelZero Summit set to take place in Singapore on June 8, as part of the broader Climate Group Asia Action Summit. The Summit will focus on bringing together decision makers and business leaders from the steel and energy sectors to accelerate Asia’s role as an economic, green powerhouse – with a clear path to net zero. It’s part of the roadmap to Climate Group’s flagship event Climate Week NYC.

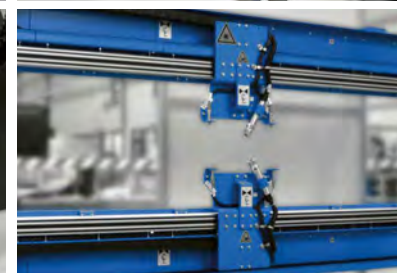
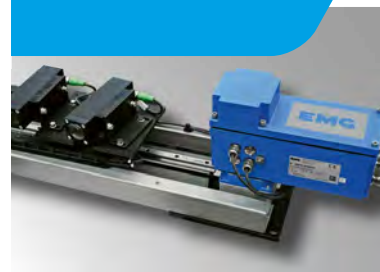
## Responsible Steel

### Global initiatives for net-zero steel

**ResponsibleSteel** is a global multistakeholder standard and certification initiative for the steel industry. Its mission is to be a driving force in the socially and environmentally responsible production of net-zero steel, globally. The ResponsibleSteel International Standard is designed to support the responsible sourcing and production of steel. It covers a range of sustainability issues including emissions, pollution, responsible sourcing, human rights, labour standards, and more.

**SteelZero** is a global initiative bringing together forward-looking organisations to speed up the transition to a net zero steel industry. Led by the international non-profit Climate Group in partnership with ResponsibleSteel, organisations that join SteelZero make a public commitment to procure, specify or stock 100% net zero steel by 2050. By harnessing their collective purchasing power and influence, SteelZero is sending a strong demand signal to shift global markets and policies towards responsible production and sourcing of steel.

**Solutions for our Climate** (SFOC) is a nonprofit organisation established in 2016 for more effective climate action and energy transition based in Seoul, South Korea. SFOC is led by legal, economic, financial and environmental experts with experience in energy and climate policy and works closely with domestic and international players.

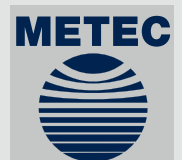


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NEW IEEFA REPORT

# A two-speed decarbonisation plan

ArcelorMittal's path to net zero emissions under scrutiny as new coal-based blast furnaces in India contrasts with low-carbon steelmaking in Europe and Canada



**ArcelorMittal: Green Steel for Europe, Blast Furnaces for India. 30 pages, Institute for Energy Economics and Financial Analysis, 2023** (Picture: IEEFA)

ArcelorMittal has a 2050 net zero emissions target and is planning to shift from coal-based blast furnaces technology to green-hydrogen based steelmaking in Europe and Canada. At the same time, the company is still building coal-consuming blast furnaces in India. In a new IEEFA report, energy finance analysts Simon Nicholas and Soroush Basirat outline the ArcelorMittal's development plans and highlight the very different technology and emissions approaches being taken in India and Europe.

Simon Nicholas, IEEFA's Lead Steel Analyst, said, "ArcelorMittal, the world's second-largest steelmaker, appears to be planning a two-speed decarbonisation, with low-CO<sub>2</sub>, hydrogen-ready, direct reduced iron (DRI) technology to be

installed overwhelmingly in developed nations while building more coal-consuming blast furnaces in the developing Global South."

On the one hand, in October 2022, ArcelorMittal broke ground on its US\$1.3 billion transition to DRI-based steelmaking in Ontario, Canada, and it has similar plans in Spain, France, Belgium and Germany.

On the other hand, AM/NS India (a joint venture with Nippon Steel of Japan) has now begun construction of two new blast furnaces at Hazira, Gujarat. The company is planning a further expansion of capacity of 5 million t/year as well as new integrated steel plants at Kendrapara (24 million t/year) and Paradip (6 million t/year) in the state of Odisha. The steelmaking technology being planned for the very large Odisha expansions has not been disclosed.

The blast furnace expansions under construction at Hazira totalling 6 million t

annual capacity will increase carbon emissions by approximately 2 t per tonne of crude steel produced – that is, around 12 million t of additional carbon dioxide equivalent emissions if running at full capacity. The further expansions being planned for Odisha would add much more if they are also based on blast furnaces.

### No breakthrough in CCUS

A 2021 report by think tank E3G and the U.S. Department of Energy's Pacific Northwest National Laboratory found that blast furnaces without CCUS will need to be phased out by 2045 for the global steel sector to be on an orderly 1.5°C pathway and no more new blast furnaces without carbon capture utilisation and storage (CCUS) should come online after 2025 to avoid stranded assets. AM/NS India's expansion plan will see two new blast furnaces – without CCUS – brought online in 2025 and 2026.

**ArcelorMittal's Indian expansion plans**

Location (Capacity)	Technology
Hazira 1A (6Mt Steel)	Coal-based BF-BOF
Hazira 1B (5Mt Steel)	Not disclosed
Kendrapara (24Mt Steel)	Not disclosed
Paradip (6Mt Steel)	Not disclosed

**Options to decarbonise BF-BOF**

CCS

- Only partial emissions reductions
- Unproven or with history of failure
- High cost with no reductions in sight
- Questionable metallurgical coal investment outlook

Bioenergy

**ArcelorMittal's hydrogen DRI plans**

Location (Capacity)	Technology
Gijón (2.3Mt DRI, 1.1Mt Steel)	H <sub>2</sub> ready DRI-EAF
Bremen & Eisenhüttenstadt (3.5Mt Steel), Hamburg (0.1Mt H <sub>2</sub> DRI)	H <sub>2</sub> ready DRI-EAF
Dunkirk (2.5Mt DRI)	H <sub>2</sub> ready DRI-EAF
Ghent (2.5Mt DRI)	H <sub>2</sub> ready DRI-EAF
Hamilton (2.5Mt DRI, 2.4Mt Steel)	H <sub>2</sub> ready DRI-EAF

**Options to decarbonise DRI & EAF**

Green hydrogen

- 100% emissions reduction potential
- Proven technologies
- Expected to be cost competitive by 2030
- Growing investment & demand globally

Renewable electricity

**ArcelorMittal plans DRI technology to be installed in Europe and Canada (right) and more blast furnaces to be built in India (left)** (Picture: IEEFA)

# Relax, it's Venti.

IEEFA Steel Analyst Soroush Basirat said, "There are no full-scale CCUS facilities for blast furnace-based steelmaking operational anywhere in the world and only a few, small pilot projects underway or planned." "In addition to a very limited track record in steel, CCUS has had a problematic and disappointing history in other sectors like power generation and gas production."

"We've observed an acceleration in hydrogen-ready DRI technology rollout recently that is leaving CCUS technology even further behind," added Nicholas. "With no major breakthrough in CCUS for coal-based steelmaking on the horizon investors should be asking questions that challenge ArcelorMittal about its Indian expansion, the technology choices being made and how that aligns with the company's 2050 net zero emissions target."

Signatories to the Climate Action 100+ initiative make up almost half of ArcelorMittal's top 20 shareholders – including Amundi, BlackRock, Invesco, Alliance-Bernstein, DWS Investment and State Street Global Advisors. In its most recent benchmark assessments in October 2022, Climate Action 100+ found that ArcelorMittal currently fails to meet a number of criteria, including that it has no short-term (2025) greenhouse gas emissions reduction target, its medium-term (2026–2035) target is not aligned with the goal of limiting global warming to 1.5°C and it has failed to decarbonise its capital expenditures.

Major international steelmakers like ArcelorMittal are keen to enter the Indian market because it is one of the key steel growth markets globally, with a planned doubling in capacity this decade alone.

Europe is already accelerating its shift away from reliance on coal-based steelmaking by developing new hydrogen-based steelmaking plants, including plans by ArcelorMittal itself. But efforts to bring the global steel sector towards net zero emissions will not be achieved if India relies on new coal-based steelmaking to meet its very high forecast demand growth.

**I** Institute for Energy Economics and Financial Analysis



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## AFRICA – SOUTH AFRICA

### Scaw Metals places orders for new hot-strip mill and meltshop expansion

**Marking the entry into the flat product market, Scaw Metals is investing in a new hot-strip mill complex and a meltshop upgrade at its facilities in Johannesburg. Scaw Metals has placed the orders for these projects with Danieli.**

Danieli will design and supply a new slab caster, a reheating furnace, the hot-strip mill and a water-treatment plant, complete with the automation systems, and new FastArc EAF that will provide the liquid steel for the new line.

The new, state-of-the-art EAF will melt scrap and DRI. It will be powered by the existing 100-MVA transformer. The furnace will be equipped with technological packages, such as Q-Safe for

the detection of potential water leaks. A vertical-curve, single-strand slab caster will produce up to 650,000 t/year of prime quality slabs in various widths. Mould-level control, breakout prediction, online mould-width adjustment and solidification modelling are advanced technological packages that ensure process stability and defect-free cast products of excellent internal and surface quality. The slab reheating furnace, sourced from the market, will be equipped with Danieli Centro Combustion-patented and proven PHL firing logic to ensure high furnace flexibility at all throughputs, maximize energy efficiency and reduce fuel consumption and emissions.

The hot rolling mill will produce strip in various widths thicknesses ranging from 1.2 to 8.0 mm. Edgers will be installed adjacent to the rougher and the first finishing stand. All finishing stands will feature HAGC, and roll bending and shifting. Danieli Automation will provide Level 1 and Level 2 process control, medium-voltage for the mill stand drives and the descaling units. The entire line will be controlled from a single pulpit in front of the finishing mill. Production is planned to start by March 2024.

■ Danieli

## THE AMERICAS – BRAZIL

### ArcelorMittal places orders bar finishing equipment and water treatment facilities

**ArcelorMittal Brasil has awarded Danieli orders for the supply of a new black bar straightening and inspection line, and a water treatment system for its new rolling mill at Barra Mansa. The rolling mill was also supplied by Danieli.**

The new straightening and inspection line will process bars from 25 to 120 mm in diameter, with straightening speeds of up to 70 m/min. The order comprises the engineering, technological supply, on-site training and advisory services. The line will include Danieli Centro

Maskin two-roll, heavy-duty straightening machines, followed by a deburring area, inline non-destructive testing services and bundle forming. Danieli will also supply the hydraulic and lubrication systems.

The new water treatment plant will replace the one serving the previous rolling mill and consist of DanFilters and the Danieli Zero Scale Pit (ZSP) technology. The pit is located under the rolling mill to collect water containing rolling mill scale mainly generated during the first rolling steps. It continuously removes

the scale from the underground flume, raises it to the mill floor where it is collected in standard skips. A key advantage of the Danieli ZSP concept is that it minimizes civil works and construction costs.

The new rolling mill and the water treatment plant are scheduled to be operational by the third quarter of 2024.

■ ArcelorMittal/Danieli

## THE AMERICAS – BRAZIL

### ArcelorMittal completes acquisition of CSP

**Following receipt of approvals pending, ArcelorMittal has completed the acquisition of Companhia Siderúrgica do Pecém (CSP).**

Commissioned in 2016, CSP produces high-quality slab at its location in the state of Ceará in northeastern Brazil. The company operates a 3-million t capacity blast

furnace and has access via conveyors to the Port of Pecém.

The acquisition offers significant operational and financial synergies and brings with it the potential for further expansions, such as the option to add primary steelmaking capacity (including direct reduced iron) and rolling and finishing capacity. Given its location, CSP also pre-

sents an opportunity to create a new low-carbon steelmaking hub, capitalizing on the state of Ceará's ambition to develop a low-cost green hydrogen hub in Pecém.

■ ArcelorMittal

## THE AMERICAS – BRAZIL

### Gerdau upgrades slab caster with process optimization and quality control solution

**Gerdau has implemented a comprehensive process optimization and quality control solution from Primetals Technologies at the continuous slab caster No. 3 in its integrated steel plant in Ouro Branco.**

The new systems are operated on virtualized servers through a software subscription model. As part of the subscription concept, Primetals Technologies provides regular updates and support for the recently installed systems. Therefore, the process optimization solutions are always up to date.

Gerdau operates three continuous casters at its Ouro Branco site. At continuous caster No. 3, the old Level 2 automation system has now been replaced by CC Optimizer, a process optimization solution from Primetals Technologies. Additionally, several expert systems will control and

optimize parts of the plant. The new solution features, among other things, automated casting speed control, condition monitoring of the secondary cooling system, and early detection of breakouts. A fully integrated quality control system enables automated quality assessments and rapid failure analyses, which are based on production data gained over the long term. All systems are operated on a software subscription basis.

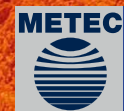
This project will virtualize all of Gerdau's servers. The necessary hardware, including the operating systems, is managed in a central data center. This solution enables lifecycle management of the server infrastructure, ensures fast scaling of services and shortens the response time of the IT team.

■ *Primetals Technologies*



**Part of the Gerdau and Primetals Technologies project team that has implemented the new process optimization and quality control solution** (Photo: Primetals Technologies)

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## THE AMERICAS

### Ternium to expand capacities in the USMCA and build wind farm in Argentina

**Ternium will integrate operations in the USMCA (United States Mexico Canada Agreement) with an upstream production capacity project. At the same time, the company is planning to build a wind farm in Argentina.**

The project comprises the construction of an electric arc furnace (EAF)-based steel shop with a capacity of 2.6 million t/year and a direct reduction (DRI) module with a capacity of 2.1 million t/year. The slab production capacity program will also include construction of a port facility for raw material handling. Ternium expects to commission these facilities in the first half of 2026.

The increased slab production capacity will complement and support the company's new state-of-the-art hot rolling mill, which began operations in mid-2021, as well as a previously announced downstream project in Mexico, which includes a push-pull pickling line and new finishing lines, in addition to a cold rolling mill and a hot-dip galvanizing line.

"The implementation of the USMCA trade agreement and recent trends of nearshoring manufacturing capacity in the steel value chain have made the USMCA region an attractive destination for continued investment," said Ternium CEO Máximo Vedoya. "The new EAF-based steel shop will also accelerate Ternium's pro-

gress towards achieving our previously disclosed 2030 decarbonization target and support our ongoing compliance with the USMCA's 'melted and poured' requirement."

Additionally, Ternium's Argentine subsidiary will build a new 72 MW wind farm from which it will source electricity in Argentina and which is expected to become operational during the second half of 2024. Ternium expects the wind farm to replace approximately 65% of the electricity that its Argentine subsidiary currently purchases from third party providers.

**| Ternium**

## THE AMERICAS – USA

### CMC orders new minimill for rebar production

**Commercial Metals Company (CMC) has awarded Danieli the order to supply a fourth hybrid-ready, MIDA QLP minimill for straight and spooled rebar. The new mill will be constructed in Berkeley County, West Virginia.**

The scrap for the 450,000 t/year minimill will be fed via endless scrap charging system into the Digimelter unit. The patented Q-One power feeders will optimize power supply to the melting and

refining units, with negligible impact on the electric network. Hybrid by design, Q-One will allow future use of renewable energies.

A single-strand Octocaster featuring a FastCast Cube oscillator and octagonal mould will be provided for endless rolling operation. The rolling mill featuring cantilever and housingless stands will produce straight bars from endless billets. Danieli will also supply its patented DBR direct rolling bundling station.

A K-Spool line incorporating a four-pass finishing block will continuously produce torsion-free deformed bars in coils of up to 5 t. Danieli Automation will provide the process control systems and make use of Danieli robotic solutions. The new minimill, named CMC Steel West Virginia, is scheduled to begin operations in late 2025.

**| Danieli**

## THE AMERICAS – USA

### SMX introduces novel marking technology to steel slabs

**SMX has successfully introduced its invisible marking technology to steel slabs at the melting stage.**

SMX (Security Matters), a company focusing on digitizing physical objects on the blockchain to enable a circular and closed loop economy, has successfully marked

steel slabs at a manufacturing facility in Europe, for brand identification, ethical sourcing and for recycle and reuse (green steel) purposes for electric vehicles and renewable energy infrastructure. The invisible SMX marking technology was introduced to the steel slabs at the melting stage and survived all manufacturing pro-

cesses – casting, hot and cold rolling, and galvanizing. SMX believes that major steel manufacturers will be aiming to use SMX technology as a new industry standard.

**| SMX**

## Pellet Cooling and Transport

### THE AMERICAS: CANADA

#### Valbruna ASW installs new electric arc furnace

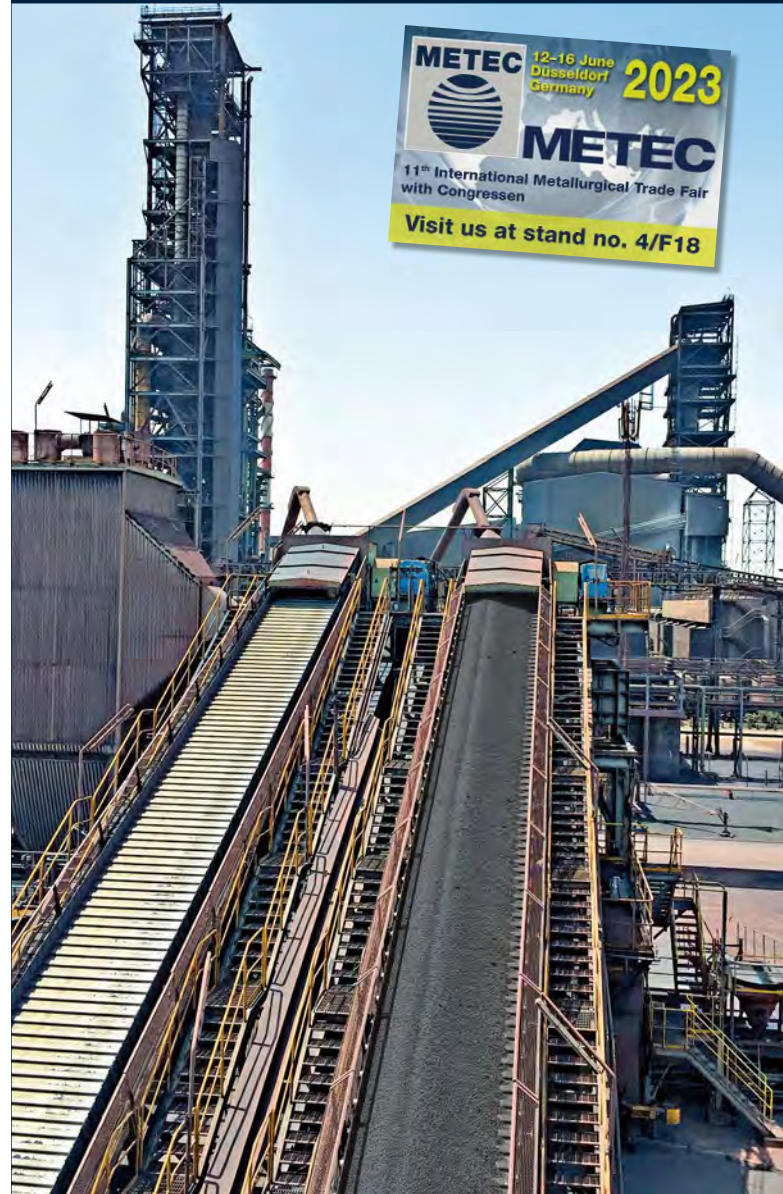
Speciality steel producer Valbruna ASW, located in Welland, Ontario, has successfully started up a new EAF supplied by Tenova as a replacement for an older EAF unit.

The spout shape of the new 70-t electric arc furnace will provide an increase in melt shop productivity and enhance production reliability. The scope of supply also included associated auxiliary equipment, the innovative TDRH 4.0 (Tenova Digital Regulator and Harmonics) electrode regulation system, the KT (Koester Technologies) chemical injection system, a ladle-charging system and the entire EAF automation.

 Tenova



Valbruna ASW has successfully commissioned its newly installed EAF  
(Photo: Tenova)



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## ASIA – BAHRAIN

### SULB to modernize electric arc furnace and continuous caster

**SULB Company BSC has commissioned SMS group for the revamp of its 130-t electric arc furnace (EAF) and its four-strand continuous caster.**

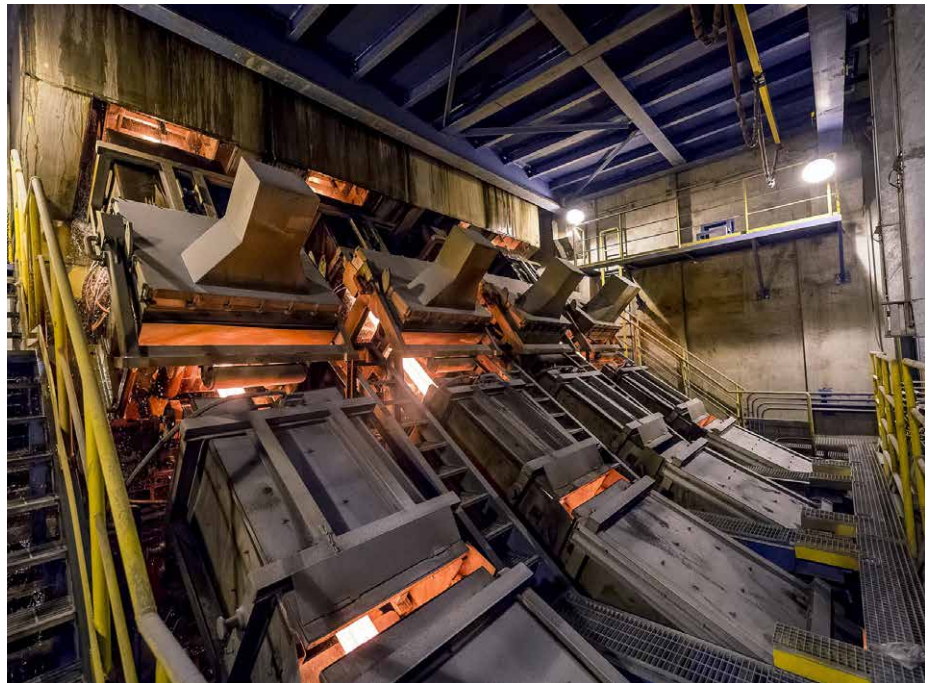
The SULB Bahrain plant has a melt shop and a medium and heavy section rolling mill supplied by SMS, encompassing the whole process from DRI to the finished steel.

As part of the EAF modernization, a CONDOOR® slag door will be installed. The aim of the upgrade is to improve furnace sealing, thus increasing productivity. The installation of the CONDOOR® slag door enhances safety for the operating personnel as the slag cleaning from the breast is performed automatically. Slag removal by forklift is no longer required. The modernization will lower specific energy consumption, increase production

yield and significantly reduce the iron oxide content in the slag.

The four-strand continuous caster is designed for the production of six section sizes. The goal of the project is to increase casting speeds and productivity through additional cooling and strand support in the upper segments. The modernization scope includes the rebuild of segment 1 for bloom and beam blank sections, including a new spray cooling system, water deflectors, a new hydraulic system and an expanded steam extraction system. This caster modernization will provide SULB more production flexibility and thus the ability to respond more effectively to market demands. Start of production of the revamped equipment is planned for 2024.

■ SMS group



Continuous billet and beam blank caster in operation at SULB (Photo: SMS group)

## ASIA – BANGLADESH

### Unitex Steel to build long-product minimill

**Unitex Steel Mills has contracted Danieli for the supply of a 1 million t/year minimill to be built in the Feni district of Chittagong, in the eastern region of Bangladesh.**

The order for Danieli covers engineering, manufacturing, procurement, supply and on-site services for the entire plant, including auxiliary fume and water treatment plants, and the electrical and automation systems. The Danieli MIDA minimill will be designed to produce 1 million t/year of long products including quenched rebars, smooth rounds, equal angles and channels. Scrap melting will take place in a 100-t Digimelter featuring a Q-One digital power feeder and continuous-scrap charging with preheating systems. The Danieli-patented power feeder provides digital arc control to reduce electrical energy and electrode consumption.

A four-strand, 9-m-radius continuous caster featuring FastCast Cube™ oscillator, Eco-Power Mould™ and EMS systems will produce a wide range of low- and medium-carbon grades at high

productivity rates. The cast billets will be directly hot-charged into a 150 t/hour walking-beam reheating furnace from Danieli Centro Combustion. This furnace will be prefabricated and refractory-lined in the Danieli workshop to reduce costs and time for the installation at the construction site.

The highly flexible merchant rolling mill will feature 18 H, V and convertible H/V stands to guarantee production flexibility and be able to also produce small-dimension deformed rounds in a multi-slit process with up to six strands. The bar finishing facility will feature a 90-m-long cooling bed equipped with a water-spray system for extra-cooling and two 12-m-long single-head magnetic stackers for sections. Danieli Automation will supply all electrical equipment, including the power distribution, Level 1 and 2 automation and process control systems. Start-up of the new Unitex Steel minimill is scheduled for the fourth quarter of 2024.

**| Danieli**

## ASIA – INDIA

### AM/NS India places orders for large-scale project

**ArcelorMittal Nippon Steel India (AM/NS India) has awarded Larsen & Toubro (L&T) various EPC orders for its large-scale expansion projects in Gujarat and Odisha. For the new flat steel complex to be built at Hazira, Gujarat, Danieli will supply two double-strand slab casters.**

The EPC orders for the Minerals & Metals (M&M) Business of L&T Construction comprise various packages: Installation of two blast furnaces (BF 2 and BF 3) of 3.5 million t/year capacity each at the Hazira plant on EPC basis, including associated supplies, construction and installation. The capacity of the existing blast furnace 1 will be increased from currently 2 million to 3 million t/year.

At the same iron and steel complex, M&M will carry out the installation of a 6 million t/year steelmaking plant. The order

scope includes the plant layout, installation of the steelmaking facility, secondary metallurgy and slab casting units. The two four-strand slab casters from Danieli will include the latest technological packages, such as solidification and dynamic soft-reduction models. The casters will be designed to produce quality slabs from 250 up to 350 mm thickness, and up to 2,200 mm width. The projects are aimed at increasing the crude steel capacity at Hazira to 15 million t/year by the first quarter of 2026.

At Sagasahi in Odisha, AM/NS India is going to build a 6 million t/year ore beneficiation plant. The corresponding EPC contract has also been placed with Larsen & Toubro.

**| Larsen & Toubro/Danieli**

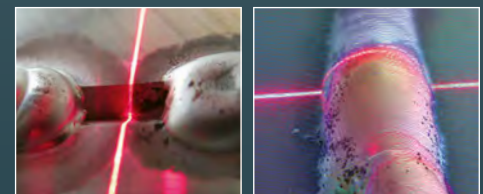


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## ASIA – INDIA

### Rungta Mines awards Danieli two new high-speed bar mills

**Rungta Mines has placed an order with Danieli for the supply of two new high-speed bar mills to be installed in Jharkhand. The mills will be designed to produce 1 million t/year of rebar in diameters ranging from 8 to 40 mm.**

The billets for the rolling mills will be produced by existing casters at the same location. The twelve-meter-long 130-mm square billets will be delivered directly to the new mills by means of a 160-m-long hot-charge system. This will make billet reheating and the installation of a reheating furnace superfluous, reducing emis-

sions as well as investment and operating costs.

Both mills will comprise 12 housingless stands and an eight-pass fast-finishing block for the high speed needed for the process. The Danieli Bar Quenching system (QTB) will provide in-line heat treatment of the bars, drastically reducing the addition of microalloys during the melting process.

Bar counters will facilitate customized bundle forming. Based on real-time production information and shipment scheduling, the Danieli yard management system will generate the material movement

orders for timely bundle preparation in the shipping areas, drastically reducing the loading times.

With this investment, Rungta Mines pursues its growth strategy and will become a key player in the Indian market for Thermo-Mechanical Treated (TMT) bar. The new mills are scheduled to start operation in the third quarter of 2024.

■ Danieli

## ASIA – THE PHILIPPINES

### SteelAsia to employ carbon-reducing technology

**SteelAsia Manufacturing Corp. is equipping its steel mill in Calaca City, Batangas, with digital solutions from SMS group that will provide a more efficient way to boost output without increasing the carbon footprint.**

SteelAsia signed a performance improvement agreement with SMS group to equip its Calaca steel plant with process automation and digitalization systems based on latest artificial intelligence to produce green steel. Under the EPICA (EAF Performance Improvement Partnership for Calaca), latest combustion technology will be employed in the electric arc furnace (EAF). Additionally, the pollution control system will be upgraded.

The digital components of this package include solutions based on artificial intelligence and machine learning. The SMS Data Factory Suite functions as the central data platform. It collects all plant data, evaluates and forwards this information to the appropriate systems, for example, to optimize real-time dashboards for KPI and plant monitoring. Here, the DataXpert software ties in. Designed to develop and manage condition monitoring and expert systems, the platform delivers real-time recommendations and notifications.

“Advanced Integrated Solutions is the day’s buzzword, and we are proud to have Calaca as the Philippines’ first steel plant to be equipped with our leading technology,” said Prof. Pino Tesè, Chief Sales Officer, India and Asia Pacific Region of SMS group. “It also means higher green steel production for the country as Calaca uses 100% renewable energy for steel-

making”, Benjamin Yao, SteelAsia Chairman and CEO added.

■ SMS group



**Benjamin Yao, (left), Chairman and CEO of SteelAsia, and Prof. Pino Tesè, Chief Sales Officer India and Asia-Pacific Region of SMS group** (Photo: SMS group)

2 2023

# STEEL+ TECHNOLOGY



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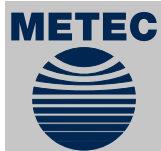
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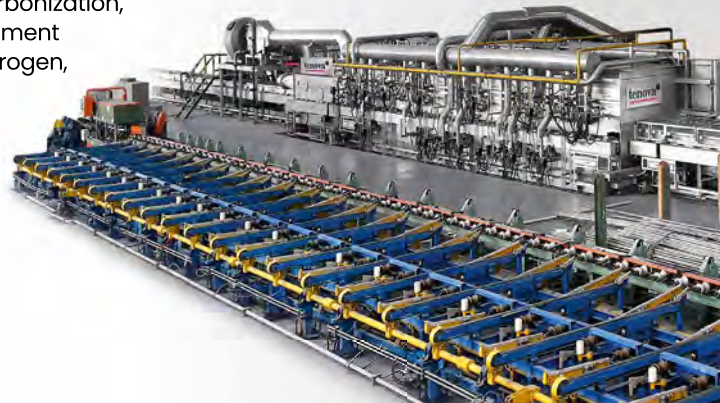
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The eleventh edition of the international metallurgy trade fair with congresses will also build on the success of 2019  
 (Photo: Messe Düsseldorf / cillmann)

## THE BRIGHT WORLD OF METALS 2023

# METEC and THERMPROCESS trade fairs as a strong platform for energy-intensive metallurgy

At the world's leading technology fairs METEC and THERMPROCESS a giant number of international exhibitors will present their technological innovations in Düsseldorf, Germany, from 12 to 16 June 2023. Then, for five days, the topics of ecoMetals, metallurgy and thermoprocessing technology will be in the focus of the world's attention in the Rhine metropolis. The trade fairs are accompanied by conferences and numerous special shows.

From 12 to 16 June 2023, Düsseldorf, Germany, will become the centre of the international foundry and metallurgy industry: the world's leading trade fairs quartet of GIFA, METEC, THERMPROCESS and NEWCAST, which take place every four years and together cover the entire spectrum of foundry technology, cast products, metallurgy and thermoprocessing technology, are particularly in demand this year among energy-intensive

industries, as the current challenges are fuelling digitisation in metal technology and their search for sustainable and forward-looking solutions.

More than 2,000 exhibitors from over 50 countries pick up on global trends and show the entire range of current technologies and products in twelve exhibition halls. The hot topics of the "Bright World of Metals" are: Decarbonisation of the metallurgical industry, ecoMetals, circular

economy, digitalisation, additive manufacturing processes as well as e-mobility and automotive lightweight construction.

"Given the current industry environment, we have a forward-looking GIFA, METEC, THERMPROCESS and NEWCAST coming up in June. With the EU's Climate Protection Plan 2050, the metallurgical industry is now tackling hot issues and, more than ever, needs a strong communication platform for global exchange.

## With the EU's Climate Protection Plan 2050, the metallurgical industry is now tackling hot issues and, more than ever, needs a strong communication platform for global exchange.

*Malte Seifert, Director of GIFA, METEC, THERMPROCESS and NEWCAST at Messe Düsseldorf GmbH*

Exhibitor feedback shows that the June meeting at the four technology trade fairs will be an absolute highlight. In addition to renown brands such as Dihag, Primetals Technologies, SMS group (METEC), or, for example Aichelin, Electrotherm and WS Wärmeprozessestechnik (THERMPROCESS) virtually all the well-known companies will be present in Düsseldorf and will be tackling the great transformation with groundbreaking innovations and ideas," explains Malte Seifert, Director of GIFA,

METEC, THERMPROCESS and NEWCAST at Messe Düsseldorf GmbH. "The relaxation of travel in the Asian region has given an additional boost to exhibitor registrations. This year, trade visitors can therefore once again look forward to the usual high level of internationality at the four trade fairs", says Malte Seifert.

Not only in terms of exhibitors, but also in terms of visitor structure, "The Bright World of Metals" lives up to its name: from experience, more than half of the

trade fair visitors come from overseas and all over Europe.

### **METEC on course for success for the eleventh time**

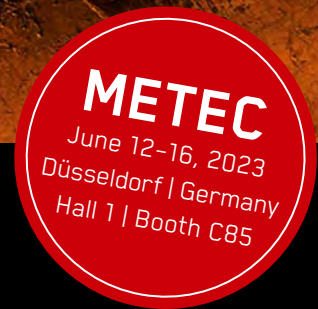
The eleventh edition of the international metallurgy trade fair with congresses will also build on the success of 2019: more than 500 exhibitors from all over the world will present plants for the production of iron, steel or non-ferrous metals or for

# MORE YIELD

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[www.dango-dienenthal.de](http://www.dango-dienenthal.de)

casting and shaping steel as well as equipment and components for metallurgical plants, rolling mills and steelworks in Halls 1, 4 and 5. Forged parts will also be on show at METEC. The exhibitor list includes: Dihag Holding (Germany), Inteco (Austria), Primetals Technologies Ltd (UK), Vesuvius (Belgium), SMS Group (Germany), Tenova S.P.A. (Italy) and Sinosteel (China).

## Industry giants at THERMPROCESS

With around 60 percent foreign participation and around 300 exhibitors, the 13th THERMPROCESS is also one of the world's leading trade fairs and a must-attend date in the calendar for the industry. This is also reflected in the current registration status with many industry giants: Aichelin (Germany), Ajax Tocco Magnethermic GmbH (Germany), ABP Induction Systems GmbH (Germany), Electrotherm (Germany), Honeywell Thermal Solutions - Elster GmbH (Germany), Inductotherm Europe Ltd (UK), Otto Junker (Germany), Seco/Warwick Europe (Poland) and WS Wärmeprozessstechnik (Germany) will be showing technological trends in industrial furnaces, industrial heat treatment plants and thermal processes for



**Virtually all the well-known companies will be present in Düsseldorf and will be tackling the great transformation with groundbreaking innovations and ideas**

(Photo: Messe Düsseldorf / ctilmann)

precious metals, hard metals, ceramics, steel and iron, as well as in the field of construction elements and equipment, operating and auxiliary materials. The manufacture of products without an ecological

footprint is a vision – the thermoprocessing industry and its suppliers will be looking at it together at the trade fair.

## Clear hall structure

For better orientation, the halls are divided according to trade fairs and main product areas and thus offer a comprehensive and optimal market overview:

- › METEC Hall 1: Forging technology
- › METEC Halls 1+4+ 5: Plant construction
- › METEC Hall 5: Components and suppliers
- › THERMPROCESS Hall 9: Thermprocess Forum and ecoMetals Forum
- › THERMPROCESS Hall 9: FOGI special show
- › GIFA Halls 10+11+12+13+15+16+17: Foundry technology
- › NEWCAST: Halls 13+14: Cast products

With new technologies, new processes for CO<sub>2</sub> reduction and avoidance, with the increased use of renewable energies and hydrogen instead of coal, "The Bright World of Metals" is on the green path to a climate-neutral future. At the ecoMetals Forum in Hall 9 on 15 and 16 June 2023, the most important topics of the transformation of the metals industry will be discussed.



**The industry portals [www.metec.de](http://www.metec.de) and [www.thermprocess.de](http://www.thermprocess.de) offer information and a wide range of services to help you prepare for your visit to the fair** (Photo: Messe Düsseldorf / ctilmann)

## Fairs and supporting programme as if from a single mould

The technical supporting programme, special shows and industry meetings also contribute to the success of the trade fairs. Worth mentioning here are:

- › Young talent programme with show foundry, 12-16 June 2023 (Hall 13, stand E50 + F52)
- › Young talent initiative "Metals4you", 12-16 June 2023 (Hall 16)
- › ESTAD (European Steel Technology and Application Days), 12-16 June 2023 (CCD South)
- › EMC (European Metallurgical Conference), 11-14 June (CCD South)
- › FOGI Special Show, 12-16 June 2023 (Hall 9, stand C42)
- › Energy Transition Theme Day, June 2023 (Hall 9, stand D74)
- › THERMPROCESS Forum, 13-14 June 2023 (Hall 9, stand D74)
- › VDMA TechTALK, 15 June 2023 (Hall 9, stand D74)

- › ecoMetals Forum, 15-16 June 2023 (Hall 9, stand D74)

## ecoMetals – the way to the future and a sustainable economy

Since 2011 the ecoMetals campaign has been a fixed component of the "Bright World of Metals". It has developed into a special highlight of the trade fair quartet. As an initiative for more sustainability, it refers to the ecological path of the foundry and metalworking industries and promotes exhibiting companies that invest in innovative, sustainable and economically competitive technologies.

Trade fair visitors will recognise the environmentally conscious innovations on the exhibition stands awarded the ecoMetals logo and in the online portal. They will be guided to the selected exhibitors at GIFA, METEC, THERMPROCESS and NEWCAST by daily free guided tours – the so-called ecoMetals Trails.

Interested visitors can buy their ticket to GMTN 2023 online in advance of the fair and thus save money and time: the online day ticket costs 55.00 euros (instead of 70.00 euros on site) and the season ticket for the entire duration of the fair 108.00 euros (instead of 138.00 euros); the student or pupil ticket is available at a price of 20.00 euros on presentation of appropriate identification.

The industry portals [www.gifa.de](http://www.gifa.de), [www.metec.de](http://www.metec.de), [www.thermprocess.de](http://www.thermprocess.de), [www.newcast.de](http://www.newcast.de) and [www.tbwom.com](http://www.tbwom.com) offer information, a wide range of services to help you prepare for your visit to the fair (e.g. interactive hall plans), to network with companies as well as the latest market trends and innovations from "The Bright World of Metals", so that you can always stay up-to-date between the years of the fair.

■ Messe Düsseldorf

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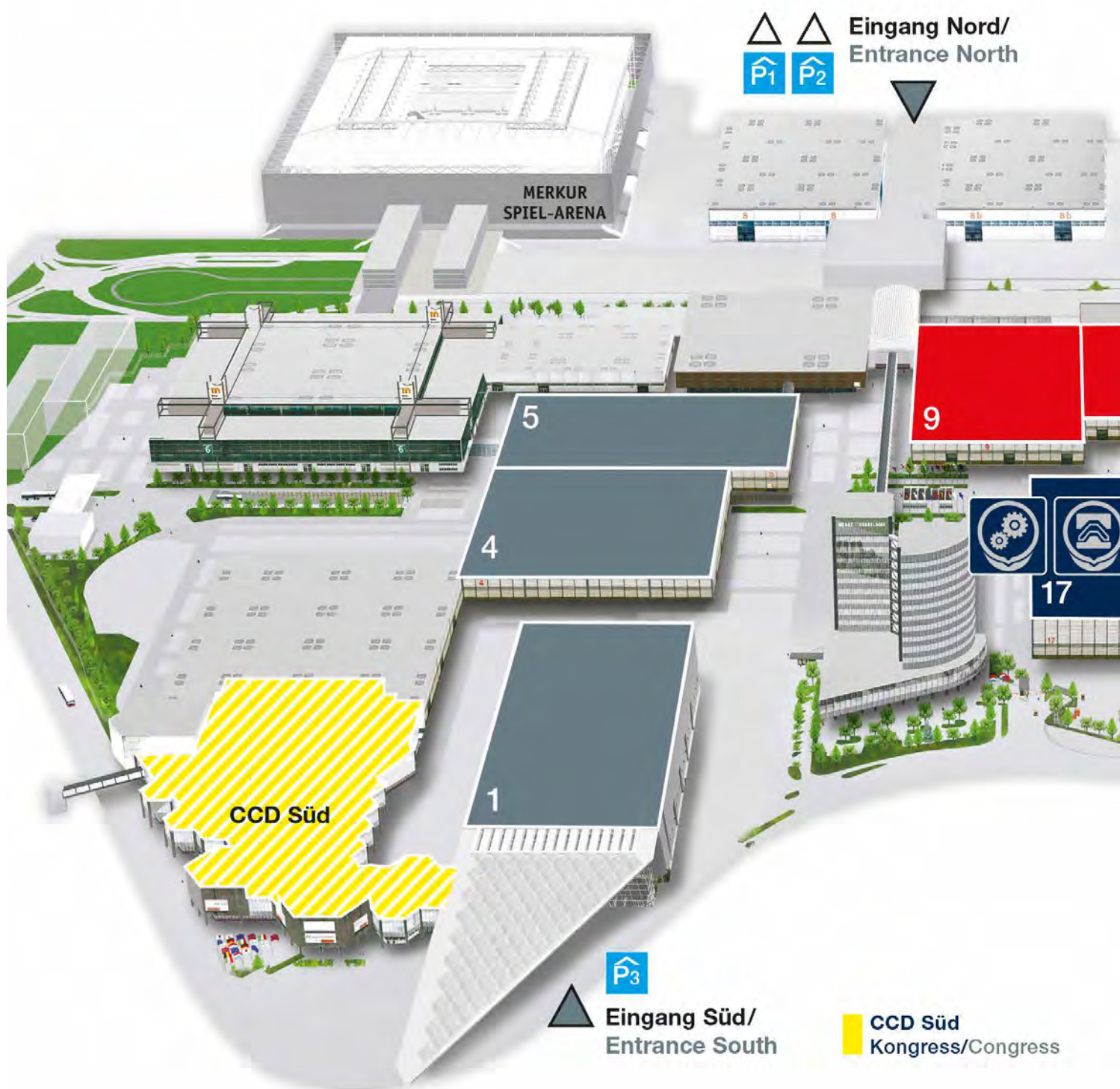


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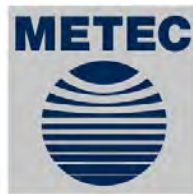
# The Bright World of Metals

DÜSSELDORF/GERMANY  
**12-16 JUNE 2023**





**Hallen/Halls**  
10-13  
15-17



**Hallen/Halls**  
1+4+5



**Hallen/Halls**  
9+10



**Hallen/Halls**  
13+14

**GIFA THEMENSCHWERPUNKTE/  
GIFA MAIN TOPICS**



**Halle/Hall 13**  
Additive Manufacturing/  
Additive manufacturing



**Halle/Hall 12**  
Anschnitt und Speisertechnik/  
Gating and feeding



**Hallen/Halls 15-17**  
Modell, Form- und Kernherstellung/  
Moulding, pattern and core making



**Halle/Hall 12**  
Gießereichemie/  
Chemical materials for foundries



**Halle/Hall 10**  
Druckguss und Peripherie/  
Die casting and peripheral equipment



**Hallen/Halls 15-17**  
Gießereimaschinen und Anlagen/  
Foundry machines and foundry plants



**Halle/Hall 16**  
Robotik/  
Robotics



**Nachwuchs-  
programm**  
Trainee  
programme

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Tel. +49 211 4560 01 \_ Fax +49 211 4560 668  
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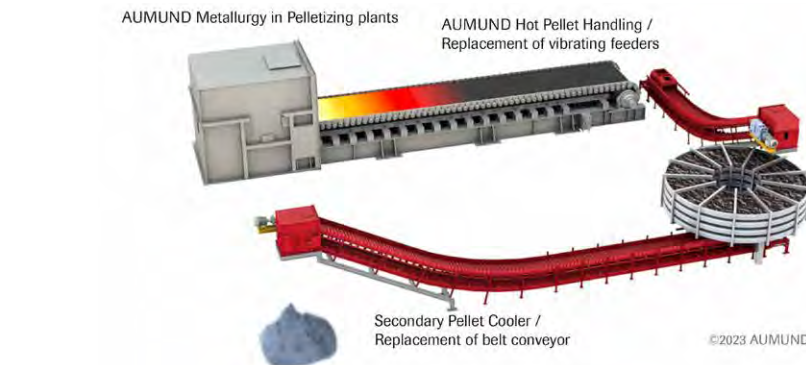


**Messe  
Düsseldorf**

## COOLING CONVEYOR TECHNOLOGY FOR HOT IRON ORE PELLETS

**Aumund Fördertechnik GmbH is an established project partner when it comes to handling hot, abrasive and chemically reactive bulk materials. The product range with its pan conveyors type KZB also includes solutions for handling and discharge of the iron oxide material which is produced in the agglomeration process of pelletising.**

The idea of an extended cooling zone with a linear air cooler presents a very interesting, efficient and cost-effective approach for many pellet producers, when they compare it with other alternatives which would consume more capital and operating expenditure. A special solution in its range will be presented with the pan conveyor type KZB-KP. KP indicates cooling with perforated conveyor sections. The physical principle is based on forced convection. Negative pressure is generated by a powerful radial blower. Air from underneath the conveyor is sucked in through the perforations of the conveyor sections and flows through the layer of pellets on the conveyor. The heat energy



**For conversions or capacity increases in pelletizing plants, pan conveyors replace for example rubber belt conveyors and vibrating feeders** (Picture: Aumund)

is transmitted from the pellets into the medium of the air flowing through them, and discharged via the exhaust hoods. An appropriate dedusting system follows downstream. This cools the product down carefully to below 100°C so that it can be transferred to the onward conveying technology without problems, and transported to the stockyard.

In metallurgy not only the handling of pellets but also of other hot bulk materials

such as DRI, HBI, sinter, coal and coke plays a particular role. Aumund's products are used here for conveying, loading, unloading, and if necessary for transportation with cooling, or conveying with gas under inert conditions.

**Aumund Fördertechnik GmbH**  
**METEC – Hall 4, stand F18**

## SAFE HANDLING OF PERMANENT MOLDS DURING INGOT CASTING

**At METEC, Dango & Dienenthal (D&D) will present the new vertical ingot ejector that pushes ingots out of the mold in a controlled manner. These features enable the machine to significantly increase both process reliability and occupational safety.**

When casting ingots in steel mills, stripping the permanent molds used to be highly hazardous for the personnel and the machines: The ingot molds had to be swung against massive objects with the crane, for example, until the ingots came loose. In addition to hazardous working conditions and barely

calculable time expenditure, damaged ingot molds, a high mechanical load on the cranes and correspondingly high wear were a daily occurrence.

Having already supplied horizontal block pushers for horizontal ingot molds, D&D will be presenting the vertical variant for upright ingot molds for the first time at METEC – for both open-bottom and sack ingot molds. The new system reduces the time required for stripping, takes up little space and feeds the ingot to the next process step in a controlled manner. It also makes the process plannable, as stripping only takes a few minutes at a time.

The ingot mold is placed on a support plate and clamped by hydraulic hold-down devices. To release the ingots from the various mold shapes, either the mold cover is removed and the ingot is gripped directly by the crane, or it is pressed out of the mold by a mandrel.

**Dango & Dienenthal Maschinenbau**  
**METEC – Hall 1, stand C85**

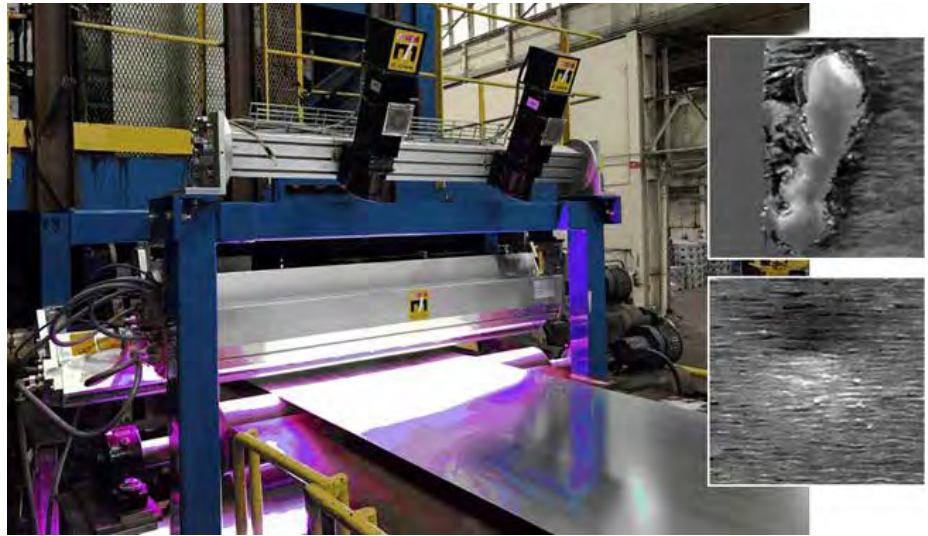


**Block pusher with sectional view of filled ingot mold** (Picture: Dango & Dienenthal)

## INTELLIGENT METAL INSPECTION

**The introduction of Dr. Schenk's MIDA (Multiple Image Defect Analysis) revolutionized metal inspection with the detection of defects using multiple views.**

The newly developed Dr. Schenk AI channel MIDA X analyzes each detected defect from multiple virtual perceptions. Defect images are sent to the classifier to determine the defect class. MIDA X then reviews the images, enhances and corrects the original physical data in real time. The corrected images are resent to the classifier, resulting in improved classification and grading accuracy. Operators know that setting the detection sensitivity of an inspection system has always been a time-consuming task. Today, MIDA X automatically adjusts the detection sensitivity, greatly simplifying the startup process and decreasing commissioning time by 25%. MIDA and MIDA X are superior to other inspection approaches. They opti-



**AI channel MIDA X analyzes each detected defect from multiple virtual perceptions**  
(Picture: Dr. Schenk)

mize process and quality control for better products and higher customer satisfaction.

**Dr. Schenk**  
METEC – Hall 1, stand E23



# JASPER

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12.-16. June 2023

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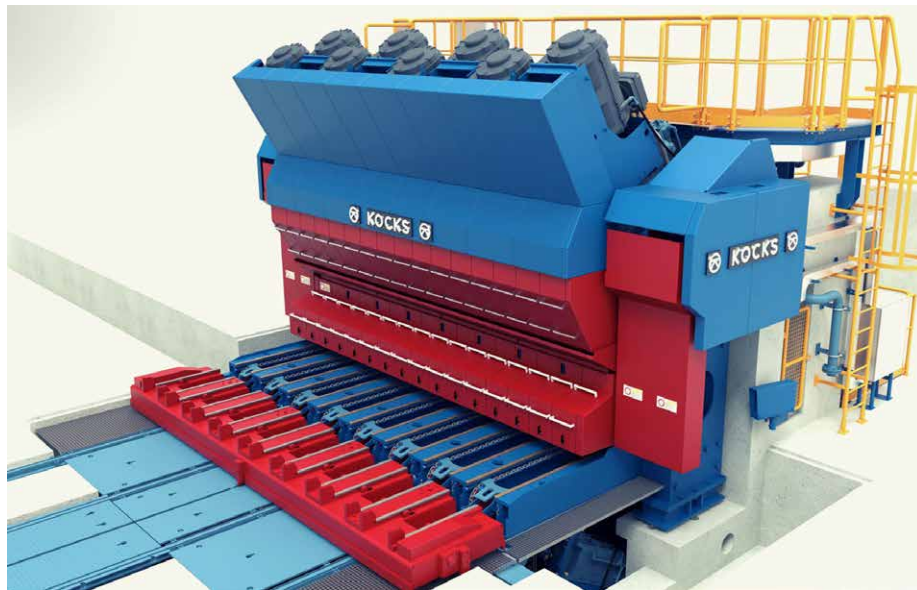


## UPDATED IRSB® MACHINE CONCEPT AS INTERMEDIATE MILL

Commonly, the proven KOCKS RSB® technology finds its application as a finishing unit in high-performance SBO-mills for rolling straight bar or bar in coil, as well as pre-finisher in high-speed sizing applications for wire rod. Now, KOCKS has made its proven 3-roll technology ready for an integration as an intermediate mill.

The iRSB® has been developed to replace traditional 2-high stands. This comes with several advantages. The 3-roll intermediate block gives rolling mill operators more options in terms of flexibility and safety. Especially in rolling mills where space is limited, still being able to add additional reduction capacities grants some very crucial advantages. For example, bigger billet sizes can be used, or a different, more flexible distribution of the reduction in the stands is feasible – which allows it to further optimize the quality of the finished product.

With an iRSB® steel producers benefit from a tailor-made rolling mill with a minimum footprint and less foundation and piping efforts. Foremost, the iRSB® not only helps optimize the overall project costs but also the operating costs with the lowest possible media and energy con-



Updated iRSB® machine concept as intermediate mill (Picture: KOCKS)

sumption per kilogram of rolled material and efficiency gains over the entire mill line, e.g. through a reduction of needed stand changes. Furthermore, the whole mill operation is simplified due to a fully automatic stand change. No overhead crane manipulation or manual, operator-requiring adjustments in the rolling mill are needed.

Visitors to KOCKS will find also a facelift of its sizing blocks and updated digital, automation and cooling solutions.

■ Friedrich Kocks GmbH & Co. KG  
METEC – Hall 1, stand A79

## INFRARED TEMPERATURE SOLUTIONS READY FOR INDUSTRY 4.0

### Vitality indicator increases the operational reliability of our pyrometers

The new generation of the CellaTemp PK and CellaTemp PX pyrometer series is equipped with two new smart functions. Every electronic measuring device is subject to ageing effects of the electronic components dependent on the level and fluctuations of the operating temperature. Ageing has a negative effect on measurement accuracy and

long-term stability. Therefore, the vitality indicator collects the operating data and monitors the progress of ageing depending on the operating temperature and hours. It indicates the right time for checking and calibrating.

The second smart function is the power supply monitor. The operating hours during which the sensor was operated with too low and too high voltage are permanently recorded. This is to prevent device defects.

The pyrometer displays the information of the smart functions and makes it available to the PLC via the IO-Link interface. This way, efficient and predictive machine and plant maintenance can be realised to increase operational safety, minimise downtimes and thus optimise availability.

■ Keller HCW GmbH  
THERMPROCESS – Hall 9, stand C60



New generation of the CellaTemp PK and CellaTemp PX pyrometer series

(Picture: Keller HCW)

## INJECTION SYSTEMS AND GUNNING UNITS FOR EAF AND LADLE METALLURGY



EAF ginning robot Hytop during operation (Picture: VELCO)

**VELCO presents their updated range of injections systems used in electric steel plants for the dosing of carbon, lime, etc. and also the wide range of equipment for refractory repair.**

In electric steelmaking, pneumatic injection systems are used to add carbon for the foaming slag process, but also lime, alternative fuels or filter dusts. The machine type EKS is equipped with a rotor type mechanical dosing system. This gives a very constant material flow even with variation of powder grain size or light humidity. All machine types can be provided as multiple dosing devices with several parallel outlets.

A further field of application is the ladle metallurgy. Here, VELCO's machine system is used among others for the carburization or desulphurization process.

### **SCRAP CUTTING – SURE SAFE!**

**Since 2018, Green Block Machine & Service offers cutting of heavy steel and iron scrap by means of a mobile cutting plant.**

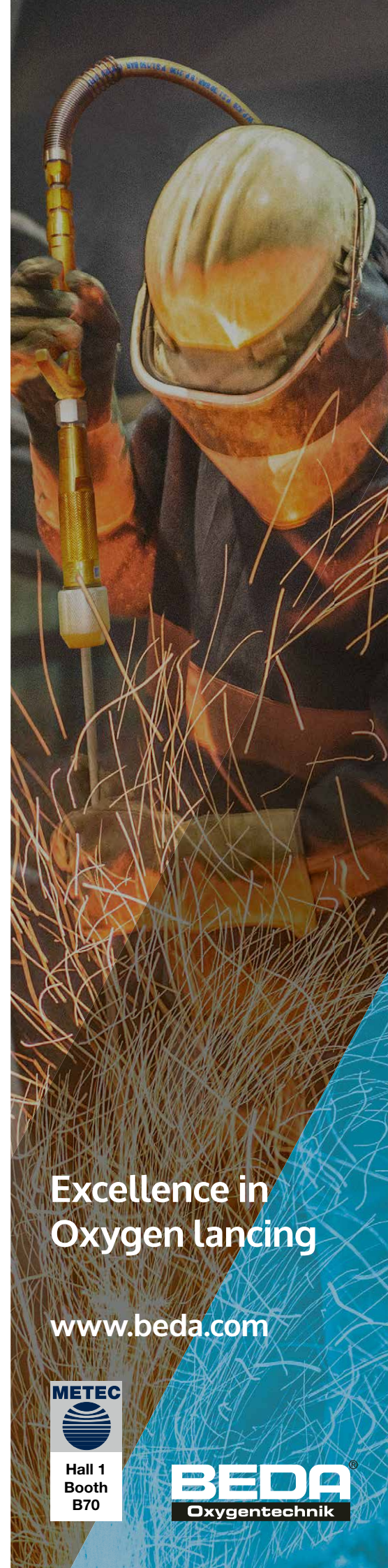
The innovative concept improves the working conditions of the scrap burner because he can control the cutting process from safe position in air-conditioned and soundproof cabin instead of holding the lance with his hands. Modern torch technology, dedusting and fully developed

For the refractory repair in steel and metallurgical plants VELCO will show its range of gunning machines and gunning robots for the hot repair of EAF, RH plants and ladles. The gunning robots allow a remote and safe hot repair of the aggregate (EAF, ladle, converter or RH degasser snorkel). Using pre-programmed sequences or the input of a laser scanner system speeds up the repair and keeps the operator safely in the control room. The gunning can be monitored and recorded by use of a video camera in the gunning head. As melt shops are not identical, VELCO offers a customized solution for each aggregate, be it a fixed installation, crane-moved or mobile unit.

■ *Velco Gesellschaft für Förder-, Spritz- und Silo-Anlagen mbH  
METEC – Hall 1, stand B47*

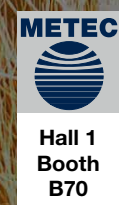
master plan ensure an efficient, safe and environmental friendly operation. From now on, interested buyers can profit from the knowhow of the scrap cutting specialist. It is possible to buy or lease these cutting plants, which can be used mobile or stationary.

■ *Green Block Machine & Service  
METEC – Hall 4, stand G01*



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## ACCURATE PREDICTION OF COLD DIMENSIONS WITHIN SECONDS AFTER FORGING

### Laser measures the entire 3D contour of forging specimens up to 1,200°C hot

Nokra will be showing for the first time its new alpha.hot3D system for 3D laser-based measurements of hot forging specimens. The system can predict the cold dimensions of a forged part in a matter of seconds after forging. This makes it possible to verify as early as the first few parts have been produced that the forming process is working without a hitch. If it is not, you can immediately take measures to adjust it.

The new alpha.hot3D system can measure parts up to 1,200°C hot, capturing their entire contour and calculating their cold dimensions with an accuracy down to  $\pm 25 \mu\text{m}$ . Consequently, the system makes it possible for the operator to adjust the forging process in a matter of seconds after the first part has been formed.

Thanks to its compact design, the system can be installed right on the working



platform of a forging press. The hot forged parts are picked up as they leave the forging press and directly placed into the measuring cell. The "within specs" or "out of specs" result of the cold-dimension calculation, including a display of the component characteristics and a target/as-is comparison, is available within just a few seconds. The system passed the acid test measuring rotationally symmetrical components produced by a hot forging press. The results differed by only between 5 and 20  $\mu\text{m}$  – much less than the operator expected.

**I** nokra Optische Prüftechnik und Automation GmbH  
METEC – Hall 1, Stand B29

**Placed into the measuring cell, the forging is rotated by a turntable during the measurement** (Picture: nokra)

## MEASUREMENT GAUGES DESIGNED FOR EXTREME CONDITIONS IN THE STEEL INDUSTRY

### DELTA presents an extensive range of gauges for non-contact measurement of length and width or position control.

The stereoscopic width measurement gauge **DigiScan XD500** has been designed for installation above the strip in cold rolling mills and processing lines. Very reasonable in terms of price and weight in its compact, robust, sealed aluminium housing, the XD500 contains state-of-the-art technology for measuring the width and

centerline of strips or plates. The stereoscopic principle allows high on-line accuracy despite material hop, tilt, lateral movement, and thickness variation of the strip.

The **VLP21/VRH** model is a specific through-beam laser barrier for extreme detection. It has been developed for a very difficult application: detection of slab, bloom, billet inside the reheating furnace. Its very high power infrared laser pulse penetrates steam, dust and vapour and

works with product or background at temperature up to 1,400°C. For any difficult detection around or inside the furnace, which is at the same time a very important task to avoid damage inside furnace, the VLP21/VRH will be extremely reliable and powerful.

DELTA also presents **Dilas FT4200**, a non-contact distance laser measurement sensor for the most difficult applications. In the steel industry, it is often used for length and width measurement as well as position control of products at the exit of reheat furnaces before discharging. Mounted in cast aluminium housing (IP66), equipped with an air jet facility in order to protect the optics and with a cooling plate for water cooling, the Dilas FT4200 is a robust sensor, which has been created for the harsh conditions of the steel industry. As accessory, a stainless steel heat shield can protect the sensor from direct radiations from hot products or furnace holes.



**Stereoscopic width gauge DigiScan XD500** (Picture: DELTA)

**I** DELTA  
METEC – Hall 4, stand D24

## VELOCITY AND LENGTH MEASUREMENT IN STRIP ROLLING AND PROCESSING LINES



Velocimeter with a protective, insulating housing on an adjustable mounting base (Picture: Polytec)

and visualized. The display of the data can be freely configured and the measured values conveniently parameterized and maintained via a web interface. Up to four users can access the system data at the same time.

By providing the new ProSpeed® LSV-1100 with the same high connectivity level as the ProSpeed® LSV-2100, Polytec makes operation and maintenance of the systems across the works easier. Both systems have the same high technological standard and are operated and maintained exactly in the same way. This is a great benefit for plant operators using both series models in their operations.

Polytec  
METEC – Hall 1, stand A54

**Polytec will be showing its new ProSpeed® LSV-1100 Laser Surface Velocimeter. Designed for enhanced connectivity and easy integration into process control, the new system model boasts the same technological level as its big brother ProSpeed® LSV-2100.**

In rolling mills and strip processing lines, surface velocimeters are used for process control functions such as mass flow regulation (Automatic Gauge Control AGC) at rolling stands. The high-precision speed and length data provided by the surface velocimeters of the ProSpeed® LSV series are used as input data for process control and process optimization. The new ProSpeed® LSV-1100 comes with the same connectivity as the ProSpeed® LSV-2100, the most comprehensive system of the series and designed, for example, to operate from larger stand-off distances. Both Polytec systems now feature various interfaces, e.g. for Profinet or Ethernet connectivity, to facilitate their integration into modern process control environments. The wide range of available interfaces makes it easy for plant engineers to integrate the system into the data environments of production plants, no matter where in the world they are going to be used.

The measured data can be transferred via a wi-fi module to the control pulpits

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**N1** in terms of ACCURACY RELIABILITY INNOVATION

THERM PROCESS Hall 9 Booth C60

## PATHWAYS TOWARDS A SUSTAINABLE AND FUTURE-ORIENTED METALLURGICAL INDUSTRY

**SMS group, one of the leading providers of metallurgical systems solutions for the steel and non-ferrous metals industries, will be showing latest technologies and solution concepts, above all for sustainable metals production. The key topics covered will be the decarbonization of production, the circular economy and the concept of an integrated lifecycle management.**

With its mission #turningmetalsgreen, SMS group is set to spur the transformation of the metals industry to become greener in the future. The goal of this mission is to create carbon-neutral and future-oriented solutions and process, develop and implement eco-friendly technologies, optimize processes and equipment, promote recycling and support its customers in achieving their sustainability targets. During the trade fair, SMS group will be giving an overview of its product and performance range, spotlighting some of its current reference projects.

SMS group's new Lifecycle Services portfolio is geared towards making processes more sustainable and more energy-efficient. To this end, SMS has combined the areas of Electrics & Automation, Technical Service and Digitalization into a powerful integrated unit. This new set-up makes it possible to provide integrated solutions that ensure and even enhance the performance of production plants during their entire lifecycle. The solutions focus on performance indicators, such as plant availability, product quality, produc-

tivity and timeliness of delivery, but also on sustainability and safety. The provision of integrated services within the framework of performance-based business models, such as Equipment-as-a-Service, forms the basis for long-term partnerships during which SMS relieves its customers from activities to give them more time and capacities to focus on their core competencies.

■ **SMS group**  
METEC – Hall 1, stand E40/41



**The exhibition stand of SMS group will be a 700-square-metre venue for exchanging ideas and networking** (Picture: SMS group)

## INTRODUCTION OF THE INCLUSION DETECTION SYSTEM FOR THIN STRIPS

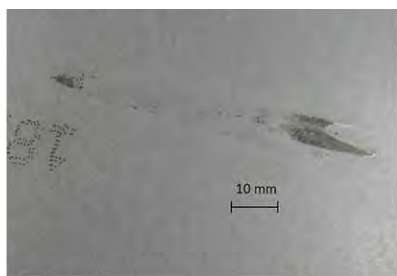
**Early detection of internal inclusions, hidden shell defects and surface defects with minimal height difference in tin plate and thin sheet**

Internal and hidden shell defects can lead to material fractures and expensive damage

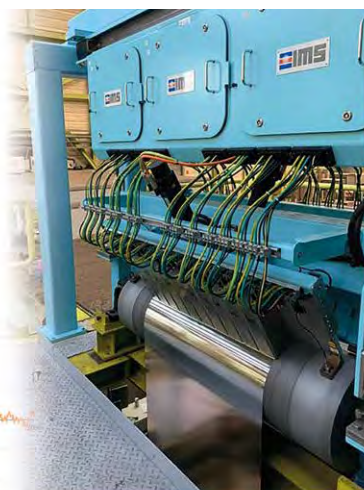
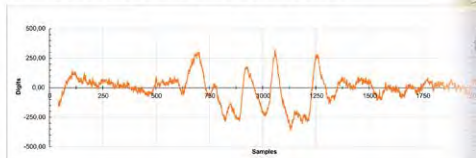
to the tools during high degrees of deformation such as the deep-drawing process. The newly developed Inclusion Detection System (IDS) from IMS is used for the early detection of these invisible material defects by means of magnetic flux leakage during the production of tin plate and thin

sheet up to 1 mm thickness. A further advantage is the reliable detection of surface defects with minimal height differences that are not detected by a purely optical surface inspection and lead to e.g. colour differences in downstream processes

Beside the innovative IDS, IMS will show the combined 2D/3D surface inspection system to prevent roll damages and broken strips in pickling lines. The system's 3D channel reliably detects serious defects such as shells, holes and wrinkles that can lead to material defects in the downstream process. The automatic depth measurement of the defects allows them to be clearly recognised, evaluated and thus reliably distinguished from harmless phenomena (e.g. soiling). In addition, the integrated 2D channel detects surface defects without height information, such as residual scale. This leads to a significant reduction of roll damages and broken strips through the reliable rejection of critical defects.



Signal Sequence Rolling and Coating Defects



**Rolling and coating defect detected at 0.66 mm thin strip** (Picture: IMS Messsysteme)

■ **IMS Messsysteme GmbH**  
METEC – Hall 1, stand C67

## MEASURING THE SHAPE AND THICKNESS OF COLD ROLLED STRIPS AND FOILS



The compact VTLG 101/1 thickness gauge can be installed in the immediate vicinity of the roll gap (Picture: Vollmer)

**Vollmer will be showing the upgraded BFI roller for shape measurement. Furthermore, the company now offers laser-based thickness gauges for strip widths up to 1,480 mm and for thin foils.**

For the measurement of the strip shape, Vollmer has digitalised the interface of the BFI roller. Communication with the mill process control system is via TCP/IP.

Parameterisation of the software and the display in the new graphic design are completely web-based. Every device with a web browser in the same network as the shape computer can display the measurement data.

With individually manufactured diameters of between 200 and 600 mm, the BFI roller can be integrated into practically any mill stand instead of deflector rolls. The

outer surface of the roll body is absolutely homogeneous and can be reground on all standard roll grinding machines. The width of the measuring zones can be freely selected above 17 mm.

As another novum, Vollmer now supplies its VTLG thickness gauges with a measurement throat depth of up to 1,480 mm so that they can record transverse thickness profiles even on wide strips. The new systems work with the same high measuring resolution of 0.1  $\mu\text{m}$  as the smaller ones used on narrower strips. Also new is the VTLG 1420/20 for measuring on strips up to 20 mm thick; with an air gap of 215 mm, they measure with an accuracy of  $\pm 5 \mu\text{m}$ .

Vollmer will also be presenting the VTLG 101/1 at the fair. It has been specially designed for the cold-rolling of foils with thicknesses between 0.003 and 2.0 mm, and is the only laser measuring system available on the market that can be installed in the immediate vicinity of the roll gap even when rolling foils. It operates with an absolute measuring precision of  $\pm 0,5 \mu\text{m}$ .

**Friedrich Vollmer Feinmessgerätebau**  
METEC – Hall 4, stand D18

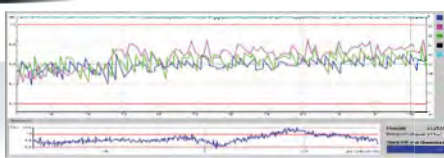


Laser geometry measurement for process optimization



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Hall 1 Booth B29

## MATERIALS ANALYSIS FROM INCOMING GOODS INSPECTION DOWN TO THE FINISHING STAGE

Secopta will be showing two new systems – one for time-saving incoming goods inspection and one for speedy, fully automatic inline PMI analyses. With the SlagLIBS system, steelmakers can efficiently check whether incoming deliveries of fluxing material comply with the chemical composition specified. For PMI (Positive Material Identification) of long products, Secopta's FiberLIBS systems now also come with a measuring head that can be placed on the product, e.g. billets, to perform a PMI analysis before reheating.

At METEC 2023, Secopta will be showing its new **SlagLIBS** system to the public for the first time. The system can be used in steelworks to analyze e.g. the chemical composition of incoming deliveries of fluxing and alloying agents – in just a few minutes. The system achieves the same high accuracy as an XRF (X-Ray Fluorescence) analysis, which is state of the art, but delivers the analysis results much faster, because SlagLIBS require minimum sample preparation. Just a quick size reduction



The compact SlagLIBS system requires only little space in the lab (Picture: Secopta)

by crushing of coarse material is adequate enough to deliver results with acceptable accuracy. This is possible to achieve with-

in few minutes after sample taking. In contrast, an XRF analysis, including sample preparation, can take up to two hours.

The **FiberLIBS** systems have already proven their competency in automatic, inline PMI (Positive Material Identification) of finished long steel products, such as bright bar, sections and pipes, that pass the analyzer at speeds of up to 2 m/s. A novelty – to be unveiled at METEC – is FiberLIBS for PMI of semi-finished products, e.g. billets, retrieved from intermediate storage for subsequent rolling. The new FiberLIBS system comes with a specially designed measuring head with integrated automatic sample preparation technology that removes the scale from the billet surface before the analysis'. The entire process takes just about 30 seconds. Thus, every batch charged is automatically 100% PMI-tested – a distinct advantage over conventional manual testing with a spark spectrometer (OES).

Secopta analytics GmbH  
METEC – Hall 4, stand A 23

## TEMPERATURE MEASUREMENT IN THE EAF DURING OPERATION

**Chameleon is an automated, optical fiber-based measuring system capable of delivering accurate temperature readings of liquid steel during the operation of electric furnaces.**

With an optical fiber, a stable temperature is quickly detected and sent to the plant

PLC to be displayed on the user interface. A semi-continuous temperature profile helps the operator accurately define the desired end point of each melting cycle. Manless operation is achieved by remote control of the Chameleon system from the safety of the control room.

› Get maximum process control

- › Optimize power on time to save energy
- › Increase safety due to manless operation

Heraeus Electro-Nite  
THERMPROCESS – Hall 10, stand A22



## Shape measurement with the BFI Roll

You can now integrate the BFI Roll with web-based communication even easier into your cold rolling process.

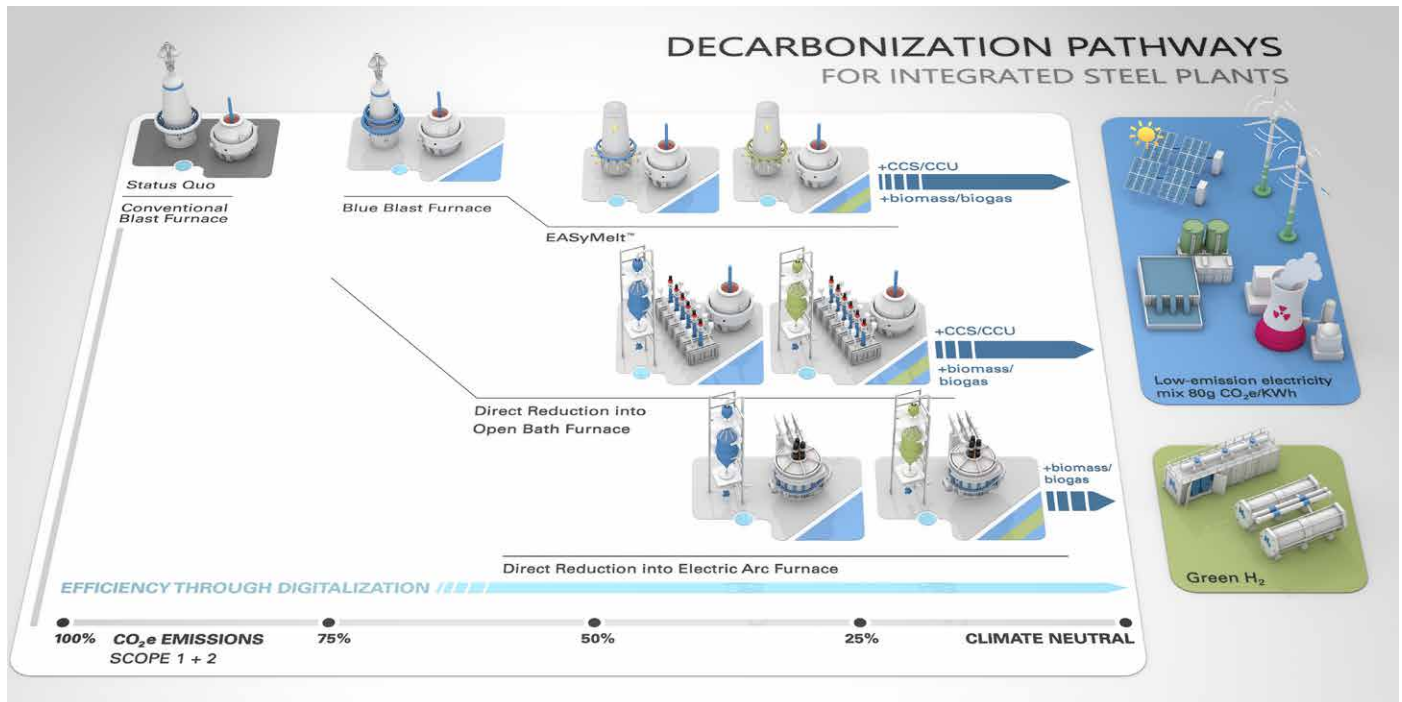


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Hall 4  
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The transformation marathon

# Pathways towards green steel

The technologies for achieving climate-neutral steelmaking are available right now – ready to be implemented in thousands of existing and future plants. How, what, when, and where that can happen depends on several factors.



Decarbonization routes for integrated steel plants (Picture: SMS group)

The green transformation of the steel industry is a marathon, not a sprint. By the middle of this decade, lighthouse projects like H2 Green Steel will prove that carbon-neutral steel production is possible. However, due to the long investment cycles for metallurgical plants, a large part of future CO<sub>2</sub> savings must come from the conversion of existing mills. But there is no one-size-fits-all 'best' option. That's why SMS group has tailor-made solutions for any customer scenario that take into account local conditions such as iron ore quality, energy infrastructure, and existing equipment, as well as local policies, rules, and regulations.

All three major decarbonization routes have the potential to achieve climate neutrality by introducing innovative integrated process solutions in new (greenfield) or existing steel (brownfield) plants and by putting in place additional infrastructure for the use of fossil-free energy sources like

hydrogen, biomass, or green electricity. Carbon capture can further be applied to go the last mile towards climate neutrality.

## Brownfield case: blue blast furnace modernization

Today, the integrated, 'primary' Blast Furnace-Basic Oxygen Furnace (BF-BOF) route is the dominant configuration for iron and steel production. Despite its high CO<sub>2</sub> emissions resulting from the use of large amounts of iron ore, mostly with low iron content, and limited amounts of scrap, blast furnace technology remains a crucial component of the iron and steel production process. Rapid greenhouse gas emissions reduction requires the gradual conversion of existing plants and infrastructure. That's why SMS group has developed the 'blue blast furnace' technology as a bridging technology on the path to a greener future in steel production.

The defining feature of the blue blast furnace and the first main step towards EASyMelt is the generation of syngas and its injection through a new bustle pipe at the lower shaft portion of the blast furnace to achieve emission reductions of up to 28 percent. Synthesis gas – or syngas – consists primarily of carbon monoxide and hydrogen and performs as a reducing gas to enable a reduction of the iron burden in the shaft, thus replacing coke.

The gas may be produced via a variety of technologies. One is a new reforming process, the so-called dry reforming of coke oven gas in reformer stoves, during which blast furnace gas and coke oven gas are reformed at a high temperature. Since the process only uses exhaust gases from the steel plant and can replace coal, the potential to reduce CO<sub>2</sub> is high. Apart from the reformer stoves, there are other available technologies to produce syngas, like the reforming of natural gas or coke oven gas and tar.



Paul Wurth, a company of SMS group, has successfully operated a pilot plant in Dillingen, Germany at ROGESA Roheisen-gesellschaft Saar mbH for testing the dry reforming process of coke oven gas with blast furnace gas. This is an important milestone in the development of dry reforming technology and the generation of syngas. The process involves producing syngas using a high-temperature catalyst-free reforming process. The first months of operation have proven the feasibility of the process, with excellent conversion ratios of up to 98 percent. The syngas produced by Paul Wurth's dry reforming process has the optimum composition and temperature for versatile use as reducing gas in the BF process, significantly surpassing the syngas quality produced by traditional catalytic reforming processes. The quality and high temperature of the reducing gas not only allow the utilization at the shaft level but also at the tuyere level.

**Brownfield case: upgrade with EASyMelt**

Based on but going beyond the emission reduction potential of the blue blast furnace, SMS group is developing EASyMelt. This electric-assisted syngas smelter will function as an alternative to the direct reduction route and as a complementary block for filling the gap between iron ore availability and green steel demand.

The concept aggregates the latest technologies developed by Paul Wurth for substituting the traditional blast furnace in integrated steel plants and helping them achieve carbon neutrality. EASyMelt is an electrified direct reduction and melting process, using a minor quantity of coke to entirely replace the traditional hot blast with gases like coke oven gas, natural gas, hydrogen, and ammonia. Depending on the energy input, the technology can achieve emission savings of above 60 percent compared to the traditional BF-BOF route. Remaining direct emissions can be reduced by applying CCS (Carbon Capture and Storage) technologies or through the use of biomass or biogas as feedstock. Using existing plants as a basis, EASyMelt is less CAPEX-intensive than any other low-carbon ironmaking technology.

The process is flexible in its input, adds resilience against supply shortages and market volatility, and can be adapted to various scenarios. Most importantly, however, traditional sinter feed may still be used in EASyMelt, avoiding fierce competition for the limited supply of (high-grade) pellets resulting with its energy flexibility to highly competitive operational costs. Just like the blue blast furnace, EASyMelt can be realized in a step-wise approach of implementing several technological elements that work together to net-zero ironmaking. The central elements are the shaft injection of reducing gas, plasma-based superheating of the tuyere injection, and finally,

the capturing of remaining emissions for storage or utilization.

**Brownfield case: direct reduction into open bath furnace**

Another leading candidate in the race to decarbonize existing sites is the combination of the well-proven MIDREX® direct reduction process using a shaft furnace and an open bath electric furnace (OBF) for substituting existing blast furnaces. SMS group supplies exactly this combination of hydrogen-powered direct reduction plant and melters to thyssenkrupp Steel in Duisburg.

The technology combines two key processes: the direct reduction of iron ore in a shaft furnace and the conversion of the resulting sponge iron into high-quality steel. Initially, it is possible to run the direct reduction plant (DRP) on a natural-gas basis, gradually introducing hydrogen at higher rates. The OBF is similar in design to a conventional Submerged Arc Furnace (SAF) operated in a so-called 'brushed arc' mode. SMS group has several hundreds of references for these kinds of furnaces.

The DRP-OBF route is both suitable for brownfield and greenfield projects. In existing steelworks, this combination replaces the BF and its associated sintering-, stove- and coke facilities. The ideal combination of a DRP and associated OBFs is to have both installed alongside one another from the start. This enables hot charging DRI to the OBF, making use of sensible energy to lower the specific energy consumption.

The combination of direct reduction based on natural gas together with an OBF already reduces CO<sub>2</sub> emissions by about 50 percent compared with the conventional BF-BOF route. These emission savings are achieved thanks to the higher hydrogen content in natural gas. In a second step, the natural gas can gradually be replaced with hydrogen as a reducing gas, which allows for further CO<sub>2</sub> reduction of up to around 65 percent.

One of the main benefits of this technology is that it reduces the need for coking coal, a key ingredient in traditional steel-making processes. The direct reduction with OBF and BOF converter technology is highly flexible and adaptable. Today's direct reduction shafts require pellets or high-grade lump ore. The OBF would then ideal-



Pilot plant for syngas generation at ROGESA (Picture: SMS group)

ly be charged with the hot DRI, significantly reducing electrical energy consumption. Alternatively, the OBF also accepts any pre-reduced iron ore feed, including hot briquetted iron (HBI), cold DRI pellets, or even DRI fines. Due to its reducing nature, the OBF is not sensitive to low ore quality, addressing the Electric Arc Furnace's inefficient processing of low-grade iron ores and making hydrogen-based green steel from low-grade ore more feasible in the future. In addition to the hot DRI fed to the OBF, up to ten percent of the OBF material feed can be comprised of agglomerated waste or free-flowing scrap. This allows steel plants to consume wastes from their existing facilities by utilizing an inexpensive agglomeration process to prepare these for addition to the furnace. The OBF can also generate a slag similar to BF slag that can be granulated and valorized in the cement industry.

**Iron making with direct reduction technology**

Based on a construction license agreement, Paul Wurth supplies MIDREX® direct reduction ironmaking plants as part of its portfolio. Midrex offers three main technologies bridging the transition from 100 percent natural gas to 100 percent hydrogen:

- › MIDREX NG™ allows up to 30 percent of natural gas to be replaced with hydrogen without equipment modifications
- › MIDREX Flex provides the flexibility to operate on any mixture of natural gas and hydrogen (up to 100 percent hydrogen) with some minor modifications.
- › MIDREX H2 is designed to use up to 100 percent hydrogen in a shaft furnace as reducing gas.

**Greenfield case: direct reduction plant and electric arc furnace**

In a greenfield project and with green hydrogen available at competitive prices in sufficient quantities, the combination of direct reduction and electric steelmaking is the best solution.

To operate any direct reduction technology while remaining competitive, sufficient natural gas or green electricity are a necessity. This is the reason why gas-based direct reduction plants have been



**The DRI plant of Algerian Qatari Steel (AQS) was supplied by Midrex and Paul Wurth as consortium partners** (Picture: SMS group)

built in locations like the Middle East, North Africa, North America, and Russia. The pre-reduced high-grade iron ore pellets are reduced in a MIDREX® shaft and then fed into an electric arc furnace as hot DRI. The EAF then melts the material and produces liquid steel. No intermediate step is required, and – depending on the MIDREX® technology in use – only minor carburization is needed to reduce the nitrogen in the steel.

Switching from natural gas use to renewable hydrogen, this route comes closest to carbon neutrality. The carbon content of low to zero carbon DRI resulting from H<sub>2</sub> reduction may be modified in the lower cone, also called the cooling zone, of the shaft furnace. Scrap can be added to the EAF with only the potential scrap contamination and quality requirements of

downstream processing stages setting an upper limit. This route is particularly interesting for greenfield projects – hence on newly constructed steelmaking sites.

The H2 Green Steel project in Boden, Sweden, is an excellent example of this technology in action and marks an important milestone in the transition of the European steel sector towards climate neutrality. This project aims to demonstrate the feasibility of producing high-quality DRI using 100 percent hydrogen as the feed gas. As the world's first almost carbon-neutral steel plant, H2 Green Steel has the potential to lead the way toward a more sustainable steelmaking industry.

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**NEW MEANS TO OPTIMIZE EAF OPERATION**

# Infrared sensor technology for state-of-the-art off-gas analysis

A new off-gas analysis technology has been successfully commissioned at the EAF of FERALPI STAHL in Riesa, Germany. Installed in the first section of the off-gas duct, the measurement system offers high potential for optimizing the melting process.

“Knowing the off-gas composition gives us a reliable picture of the EAF’s chemical profile.”

*Dariusz Sosin, Head of Production at FERALPI STAHL, Riesa, Germany*

Hence, a major goal is to save energy by optimizing the melting process in the furnace. At the EAF, one of the key performance indicators is the off-gas composition, particularly the CO<sub>2</sub>/CO ratio. The CO<sub>2</sub>/CO ratio in the off-gas and the energy consumption of the EAF are correlated.

Thus, quick off-gas measurement and analysis is an indispensable prerequisite for the reliable control of the EAF parameters, e.g. by actuation of the oxygen lance, the gas burners and coal injection.

There are publications available that scientifically describe the effect of the CO<sub>2</sub>/CO ratio on the energy losses of the furnace. The saving can easily be higher than 10 kWh per ton of steel.

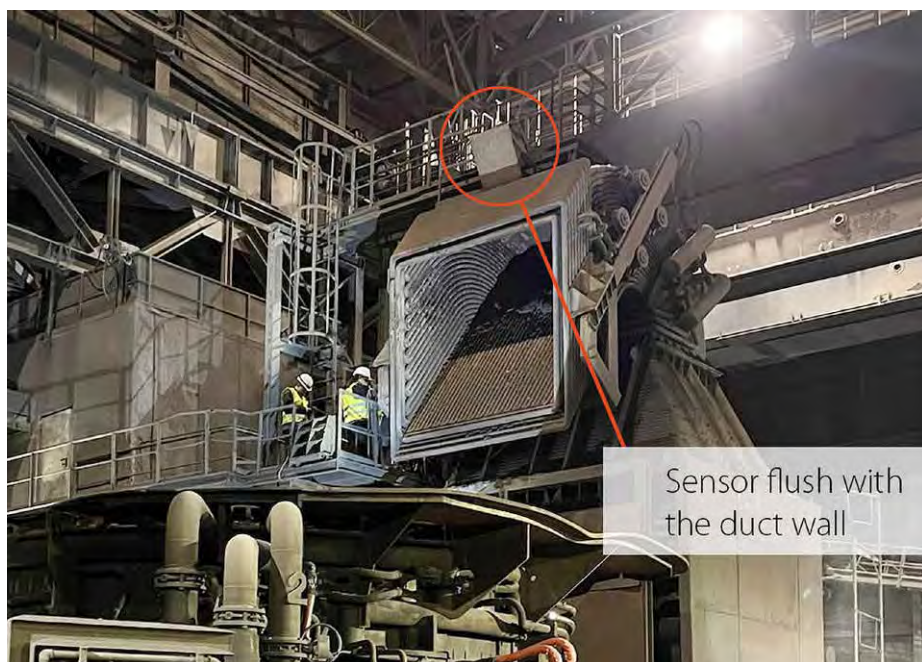
Electric steelmaking using an electric arc furnace (EAF) requires huge amounts of energy. At FERALPI STAHL, the German branch of FERALPI Group, the 100-t electric arc furnace con-

sumes more than 1.5 GWh of electrical energy every day the production runs. With the current high market prices, electricity costs can easily rise to more than 150,000 euros per day.

## Deficiencies of the previous off-gas measurement technology

In the past, the operating engineers at FERALPI STAHL used an extractive measurement system to check the composition of the exhaust gas. Gas samples were taken from the duct by a probe and subsequently analyzed. That system had proved inadequate for several reasons. First, there was a delay between the gas sampling and the availability of the analysis result. If it takes a minute to decide, this is simply too slow for an effective control of the furnace. Second, the sample hardly represented the average gas composition. Only a very small portion of the highly dynamic gas flow was sampled by means of a single probe and only in a specific area. This is the general disadvantage of using a single probe in a turbulent atmosphere compared to newer techniques based on laser measurements.

However, the sampling method has even more drawbacks: The probe requires



At FERALPI STAHL, the McON IR sensors are applied behind the “elbow” at the first section of the off-gas duct (Picture: PROMECON)



**Outer parts of the sensors applied at the EAF of FERALPI STAHL in Riesa, Germany**  
(Picture: PROMECON)

water cooling, and the most serious disadvantage of all is the excessive maintenance the extractive probe requires.

### **New infrared measuring technology**

PROMECON has introduced a new patented measuring technology for measuring no less than the CO<sub>2</sub>, CO and water contents, gas velocity, gas temperature and enthalpy flow. The sensors are mounted directly on the duct wall, do not protrude into the duct and sit 100% flush with the duct. They cover a large part of the duct's cross section and can easily measure through the cold post-combustion air layer. Thus, a large part of the off-gas stream is monitored.

The new infrared measurement technology has been introduced worldwide in electric steelmaking. Starting in 2021, PROMECON commissioned infrared sensors at ABS in Italy, followed by Jindal Steel in Oman, at Colakoglu in Turkey and now at FERALPI STAHL in Riesa, Germany. The system has been in operation at some of these sites for more than a year and has proved to be reliable and require extremely little maintenance.

The signals obtained from the system have been compared with extractive methods. They show very good correlation with the results of extractive gas analyzers.

The system responds very quickly to changes in the process, so that it can be used by the operator to optimize the process by making changes to the combustion. Especially the CO<sub>2</sub>/CO ratio is critical to the amount of energy used inside the furnace before it escapes through the fourth hole. This is also an important issue for scrap preheating furnaces.

### **Encouraging test results at the shop floor**

After installing the sensors at the EAF in Riesa, the new measuring system showed the results expected. Adding foaming coal to the heat can now be observed as a change in CO<sub>2</sub>/CO content with minimum delay. The measurement delay of just a few seconds is equal to the gas transit time. Plant operators can now optimally adjust the CO<sub>2</sub>/CO ratio by means of free variables, namely the oxygen at the burners and the lances, and the injection of foaming coal.

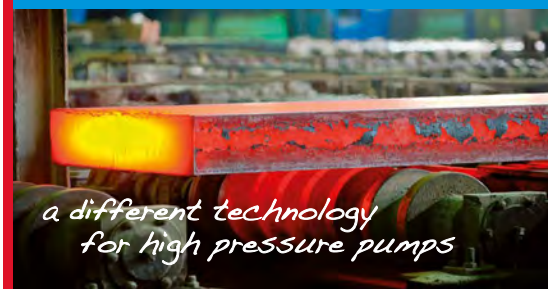


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The settings for oxygen and coal injection can be made manually or be part of a control loop that allows the operator to select a target value for the CO<sub>2</sub>/CO ratio. In the latter case, the target value is automatically achieved, with the operator having to pay no more attention to it.

The collaboration between PROMECON and FERALPI STAHL has been very productive throughout the project, and the system has proved to be much more robust in service than the previous technology. The signals can be used by the operators to optimize the gas burners and oxygen lancing to achieve cost savings. The plant operator is convinced that this will result in a short ROI.

The plant management at Riesa has been very pleased with the reliability of the system and its responsiveness to changes in the operational settings.

“The system has worked very well from the first weeks of its installation. Knowing the off-gas composition gives us a reliable picture of the EAF’s chemical profile. In the past, sampling with an

extractive system was very complicated and the values were only available after a few minutes, plus we had major maintenance problems. Now we instantly see the values and our melt shop staff do not have to check the system every day,” explains Dariusz Sosin, Production Manager at FERALPI STAHL in Riesa.

**Next step: reliable water leakage detection**

PROMECON recently introduced a water sensor for measuring the water or vapour content in the exhaust gas. Water vapour in the exhaust gas can come from the gas burners, from wet scrap or from electrode cooling. However, steam can also result from leaks in the water-cooling system. This is very risky for the furnace operation. PROMECON has developed and patented a water leakage detection system that uses the water vapour levels in the exhaust gas to detect leaks in the plant’s cooling system. FERALPI STAHL has expressed its interest in this technol-

ogy and may be conducting tests with the system.

**Conclusion**

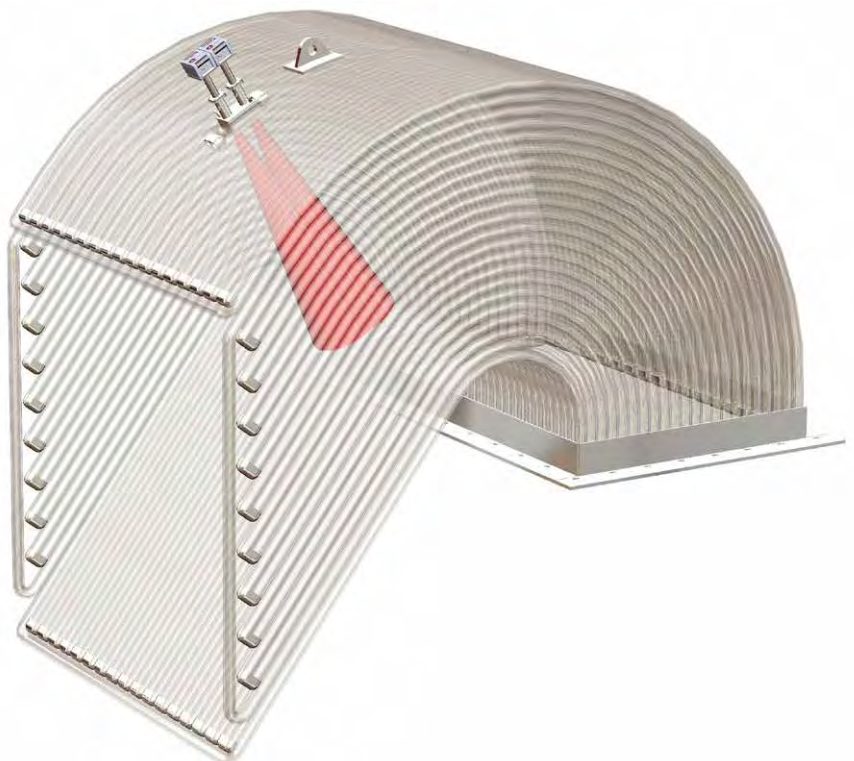
The first McON IR systems installed have proved very successful. The instant availability of highly useful off-gas information and the very low maintenance requirements have convinced the users. This 3rd generation EAF monitoring technology offers many advantages such as non-intrusive real-time measurement and a short amortization period. It is anticipated that many steel mills around the world will be interested in the benefits of this new technology.

Several major manufacturers of EAFs and EAF control systems, such as DANIELI and AMI, are cooperating with PROMECON on this new technology, with the first joint installations already in operation.

■ PROMECON



**McON IR sensor for off-gas monitoring**  
(Picture: PROMECON)



**The sensors cover a large part of the cross section and can even measure through the cold post-combustion air** (Picture: PROMECON)



Hot Box Mover, Hot Box and the tipping device in the outside area of the steel plant (Picture: TML)

## MORE SAFETY IN METALLURGICAL PLANTS

# Revolutionary solution for hot slag transport

Handling liquid slag is an ongoing accompanying process, involving significant risks and danger. The remotely controlled Hot Box Mover is an automatic solution for safe and efficient transport of liquid slag. How exactly this machine works and how it can help to revolutionize slag logistics is explained in this article.

Transporting the hot slag from under an electric arc furnace previously meant that slag transporters had to drive under the hot furnace to position the slag pots. The glowing liquid slag was then poured into these pots.

There are certain risks associated with this process as the hot slag may splash out of the slag pots causing serious injury and damage. In numerous other plants, the slag is also discharged directly onto

the ground then picked up and transported away with wheel loaders or crawler loaders.

The access roads are quite often very narrow, making it difficult for heavy machinery to reach this area safely. This has often led to accidents and machine failures. All that could now be a thing of the past.

With the pioneering solution from TML Technik GmbH, the entire process chang-

es. The patented Hot Box Mover redefines slag logistics.

The Hot Box Mover has been in use at the steelworks service provider Alliance Green Services AGS Europe in a German steel mill for quite some time, where it is being used and tested extensively. It has been already noticed: With the Hot Box Mover and the Hot Boxes lined with refractory material, the transport of liquid slag is safer and more efficient than ever before!

The traditional slag pots with their round shapes have been replaced by rectangular Hot Boxes. The giant slag pot transporters, with the driver sitting dangerously close to the hot pot, have been replaced by the remote-controlled Hot Box Mover. The Hot Boxes are moved remotely into the respective working area, in this case under a furnace, with the help of the mover, which, through its ability to turn on the spot, makes it considerably easier to access the confined working areas.

**The know-how that we have in the hot area fitted perfectly with the development of the Hot Box Mover. We know how to optimally protect from the effects of intense heat.**

*Christof Mikat, managing director at TML Technik GmbH*

The Hot Box Mover is controlled by an operator who operates the machine from a safe distance using a radio remote control, incorporating a camera display. Thanks to the electro-hydraulic pilot controls, the machine can be controlled sensitively and precisely, which significantly increases efficiency and safety.

As soon as the Hot Box is positioned under the furnace, the mover lowers the box and drives away. The slag is then poured into the Hot Box. The operator and the machine are already at a safe distance here. Once the slag has been completely poured into the box, the operator drives the Hot Box Mover under the box, lifts it up safely, moves it to a suitable location and leaves it there to cool.

Immediately afterwards, the Hot Box Mover picks up an already cooled down

Hot Box and takes it to a special tipping device which empties the solidified contents of the container independently. In this way, the Hot Box Mover can pick up another empty Hot Box in the meantime and place it ready for the next pour. By using multiple Hot Boxes, the process can run seamlessly and efficiently without creating bottlenecks or stressful working conditions. Because in a hazardous environment there is an increased risk of accidents, which must be avoided.

The Hot Box offers a decisive advantage over conventional slag pots: a larger surface area. This virtually eliminates the possibility of splashing or boiling over. A large surface area also speeds up the settling of foamy slag. This is invaluable for work safety and significantly minimizes the risk of injury and equipment damage.

The Hot Box also offers the advantage, that the slag can cool down in the box. The over-carried metal sinks to the bottom and solidifies into a thin slab block instead of the metal skulls we know from the round or oval slag pots. This ingot can be easily crushed with a free-fall weight and returned directly into the process as scrap, creating a cycle that produces much less slag waste. Compared to the time-consuming and dangerous cutting of the metal skulls with an oxygen lance and drop ball guided by a crane, this increases the working safety while saving an enormous amount of time and money.

The innovative slag transport process with the Hot Box Mover as the main actor represents a significant improvement in working safety. The risk of injury and accidents is minimized while the efficiency of the process is increased. The introduction of this new process is an important step forward for the entire industry and underscores the high commitment to occupational safety of employees in the steel and metallurgical industry.

Significant advantages of slag logistics with the Hot Box Mover at a glance:

- › removal of the operator from the hazardous activity,
- › elimination of liquid slag tipping into open pits,
- › significant reduction of safety risks associated with the transport of liquid slag within the plant,
- › elimination of slag pit areas,
- › discharge of slag directly at points of processing,
- › reduction of all emissions,
- › increase in metallic recovery,
- › improvement of metal quality,
- › elimination of flame cutting with an oxygen lance,
- › added value to the plant through reduced service charges and additional improvements in total cost of ownership,
- › reduction of the fleet by eliminating conventional slag transporters and reducing the number of other machines involved in the process,
- › cost savings due to reduced maintenance and operating personnel.

These advantages make the innovative vehicle an indispensable new development in the metallurgical industry and show its potential to change the way slag is handled. It started out as just an idea, and the more it develops, the more bene-



Hot Box filled with liquid slag leaving the steel plant on a Hot Box Mover (Picture: TML)



Remotely controlled, the Hot Box Mover positions the Hot Box under the furnace (Picture: TML)

fits and potentials are becoming apparent through this process change.

The future vision of the Hot Box Mover is to expand its autonomous driving capability. As soon as the mover receives a start signal, it should be able to find, pick up and transport the Hot Box on its own and bring it to the desired location, where it will then be automatically unloaded. This innovation makes the workflow even more efficient and safer. A fully autonomous solution is currently being worked on, while the machines are already equipped with remote control as standard. We are excited about what the future will bring.

"The fact that a TML machine can be used for intralogistics transport tasks is certainly new for many customers", says Christof Mikat, managing director at TML Technik GmbH. "We are known for breaking out the refractory lining with the debricking machine Unidachs and for spraying unshaped refractory material with the spraying manipulator Shooter, in the metallurgical industry. However, the know-how that we have in the hot area



Hot Box Mover with Hot Box entering the tipping device (Picture: TML)

fitted perfectly with the development of the Hot Box Mover: We know how to optimally protect all components from the effects of intense heat."

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**DIGITALIZATION**

# High-quality scheduling system for complex steel production lines

Nucor Steel Gallatin has integrated a management execution system into its new steel production lines. Process data flow has been improved due to integration with the enterprise resource planning system and the quality execution system as well.

**N**ucor Steel Gallatin produced the first coil following a comprehensive upgrade of its production lines using the Manufacturing Execution Suite (MES 4.0®) at its Gallatin steel plant in Ghent, Kentucky, USA. The new production planning and scheduling system replaces a legacy system developed in-house by Nucor. Following an incremental implementation and software commissioning, the MES project was successfully completed and integrated throughout the plant.

Nucor can now improve its production planning with a comprehensive modular system, comprising state-of-the-art technology components such as the Technical Order Generator, Capacity Planner, Production Sequencer, Short Term Scheduling, Quality Manager, and Production Controller. In addition to MES 4.0®, SMS also offers a Business Intelligence Manager to optimize business analysis and reporting for better evaluation of the company's productivity and key performance indicators.

The integration between MES 4.0® and Nucor's ERP system was redesigned and implemented at the same time. As a result, areas of responsibility can be clearly divided between the systems, resulting in improved planning options and the possibility of rescheduling orders in the short term. MES 4.0® was developed and implemented with state-of-the-art technology using advanced data-driven production planning and quality management methods. The system allows product rejects to be minimized while simultaneously improving product quality for a faster return on investment. "The MES production planning system gives Nucor better transparency. The fully integrated system will also enable significant savings of valuable resources in production processes

in the future," said Prof. Dr.-Ing. Katja Windt, Chief Digitalization Officer at SMS group.

## Integration from the melt shop down to the strip processing lines

In the first stage, the brownfield extension was applied to all existing production lines at Nucor. After several integration tests and a successful shadow mode period, in which production data was run through the upgraded system in parallel, the new MES took over from the existing system and went live within just sixteen hours. The new production lines, consisting of a new melt shop, a caster, an extension of the hot strip mill (HSM), and a pickling and galvanizing (PGL) line, were subsequently included in the upgrade. "It is vital for us as a manufacturing company to produce as efficiently as possible and optimize the allocation of resources. With SMS, we have a highly specialized and extremely

versatile expert to accompany us in this transformation process," said Tamera Vaughan, Information Technology Supervisor at Nucor Steel.

SMS digital's solutions are able to integrate all third-party interfaces to map the entire production process. In the context of digitalization, MES 4.0® works in conjunction with quality management software. The crucial factor behind Nucor's decision to collaborate with SMS in the digital connectivity of the new production lines by means of MES 4.0® was the high expertise resulting from the combination of proven technology and digitalization solutions. The final commissioning took place during Nucor's annual shutdown. By implementing a successful remote commissioning strategy, SMS was able to respond flexibly to Nucor's expansion schedule.

■ SMS group



**SMS and Nucor project team on site at Nucor in Ghent, Kentucky, USA, from left: Brian Frye (Nucor), Markus Schulte (SMS), Ken Minor (Nucor), Dr. Franck Adjogble (SMS), Prof. Dr.-Ing. Katja Windt (SMS), Maggie Schneider (Nucor), and Joana Kunkel (SMS)**  
(Picture: SMS group)

**EQUALLY SUITABLE AS NEW EQUIPMENT OR FOR CONVERSIONS**

## Cooling conveyor technology for hot iron ore pellets

As a supplier of specialist conveying solutions for metallurgical processes in metals industries, Aumund has gained expertise in handling hot, abrasive and chemically reactive bulk materials. The product range with its pan conveyors type KZB also includes solutions for handling and discharge of the iron oxide material which is produced in the agglomeration process of pelletising.



**In the foreground, Bahrain Steel Company plant with two pan conveyors type KZB-K for conveying and cooling iron ore pellets at a capacity of up to 1,410 t/hour per conveyor. In the background the steelworks SULB Bahrain with a Midrex direct reduction plant and hot DRI charging** (Picture: Aumund)

When planning a pelletising plant the dimensioning of the cooler is a decisive factor in the overall cost of the plant. Even if the cooling capacity is sufficiently calibrated at the time of commissioning, continuous optimisation of the plant can achieve an increase in the temperature of granulate exiting the cooler, and therefore an increase in productivity. In some plants even a doubling of the planned capacity has been achieved.

As a standard, belt conveyors are used downstream of the cooler. These are rubber belt conveyors originally designed for material temperatures of up to 100°C, but installed in situations where they have to work with temperatures up to 600°C and more. Depending on the plant, pellets are generally transported to a storage yard, a logistics centre or to a port. Both for new equipment and for conversions or capacity expansion, a metallic plate conveyor is more appropriate than a rubber belt conveyor.

Hot pellets at temperatures up to 900°C can be transported with Aumund Pan Conveyors from the rotary furnace to the cooler, and also onwards from the cooler. Additional air-cooling for hot pellets where the main cooler does not provide sufficient cooling is carried out by a special Aumund Cooling Conveyor suitably equipped with an air flow system, which is also fitted with dedusting equipment at the inlet.

In particular, when production increases and the cooling capacity of existing stationary equipment reaches its limit, the Aumund idea of an extended cooling zone with an Aumund Linear Air Cooler presents a very interesting, efficient and cost-effective approach for many pellet producers, when they compare it with oth-

er alternatives which would consume more capital and operating expenditure.

A special solution in the Aumund Metallurgy range is presented with the Pan Conveyor type KZB-KP. KP indicates cooling with perforated conveyor sections. The physical principle is based on forced convection. Negative pressure is generated by a powerful radial blower. Air from underneath the conveyor is sucked in through the perforations of the conveyor sections and flows through the layer of pellets on the conveyor. The heat energy is transmitted from the pellets into the medium of the air flowing through them, and discharged via the exhaust hoods. An appropriate dedusting system follows downstream. This cools the product down carefully to below 100°C so that it can be transferred to the onward conveying technology without problems, and transported to the stockyard.

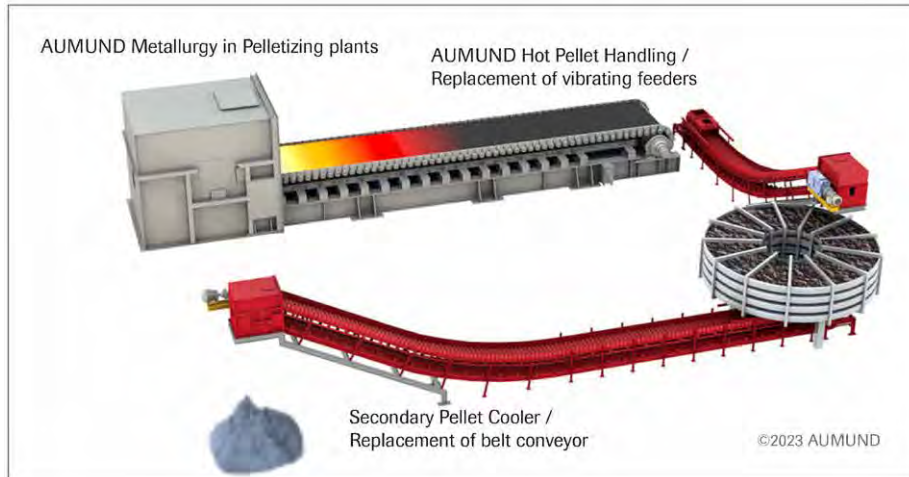
Aumund has received an order for a 100 m long KZB-KP for a conversion project to increase the capacity of the existing pelleting plant in an Eastern European steelworks. The conveyor will lengthen the existing cooling line and cool the iron ore pellets. A customer in Tasmania, Australia is also interested in installing the Aumund KZB-KP solution.

**Conveyors for other metallurgical processes**

In metallurgy not only the handling of pellets but also of other hot bulk materials such as DRI, HBI, sinter, coal and coke plays a particular role. Aumund products are used here for conveying, loading, unloading, and if necessary for transportation with cooling, or conveying with gas under inert conditions.

In the development of CO<sub>2</sub> reduced production processes in the iron and steel industry, **direct reduction** has proved its value as an alternative to the classic blast furnace process, by which sinter and coke are used as charge. Direct reduction using natural gas produces sponge iron from iron ore pellets. Depending on the technology the sponge iron products are either DRI (direct reduced iron) or HBI (hot briquetted iron).

A Hot Material Conveyor feeds the material continuously from the direct reduction plant straight into an EAF (electric arc furnace), which increases the production rate considerably and saves energy. Aumund Hot DRI Charging transports



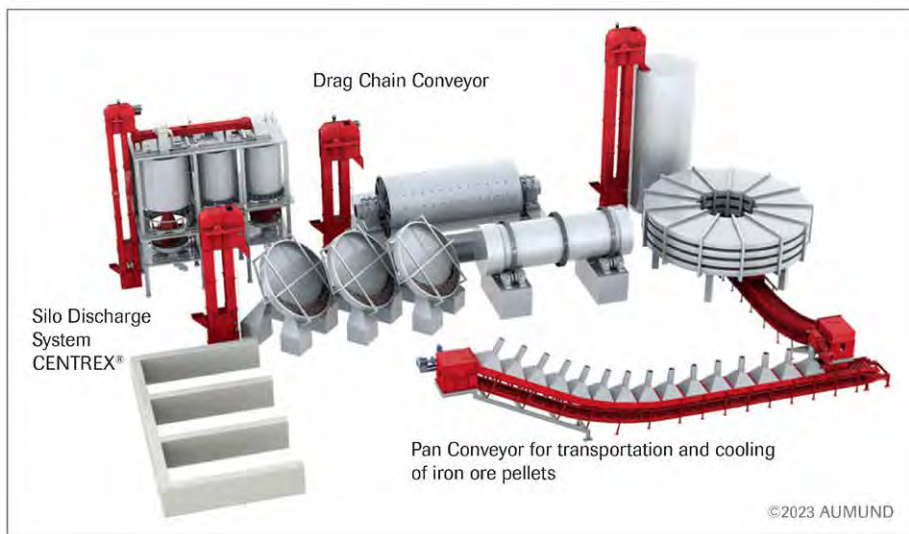
**For conversions or capacity increases in pelleting plants, Aumund solutions replace for example rubber belt conveyors and vibrating feeders** (Picture: Aumund)

hot **DRI** on an Aumund Bucket Apron Conveyor under heat-insulated and inert, non-oxidising conditions from the MID-REX direct reduction shaft furnace directly into the EAF of the steel plant. The main advantages of charging hot DRI into the EAF are reduced energy consumption and shorter melting cycle times.

To convey and cool **HBI** the patented Aumund mist cooling process is used. The HBI is sprayed with water mist on an Aumund Flat Plate Conveyor and cooled down, for example from 800°C to 100°C, in a way which does not damage the material (HBI Slow Cooling). Aumund has its own software to calculate the geometrical design of the Cooling Conveyor according

to the prevailing conditions. As well as the length and width, the final temperature can be determined in advance in connection with conveying speed. A maximum temperature below 100°C is required for the transportation of HBI to its interim storage facility and onwards by ship or rail.

Aumund Sinter Conveyors are used for transporting hot **sinter** at temperatures of up to 1,100°C from the sintering machine to the cooler, and also after the cooler if the material is still too hot for standard belt conveyors. Modern sinter shaft coolers use the heat energy from the hot sinter and are connected by insulated Aumund Sinter Conveyors in order to optimise energy recovery.



**Aumund has various conveying systems for horizontal, vertical or inclined transportation of bulk materials on offer for materials handling and material cooling in pelleting plants** (Picture: Aumund)



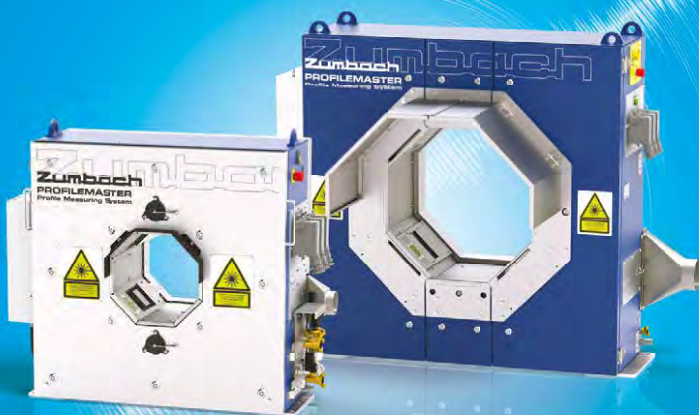
Aumund pan conveyor type KZB-S in a sintering plant (Picture: Aumund)

Aumund conveying equipment is used in coal treatment, for transporting the **coke** to the coke oven, and in wet quenching. Rotary Discharge Machines type LOUISE BEW and Rotary Plough Feeders type Besta & Meyer RFX reliably clear the coke from the coke ramp after quenching. Alternatively the coke can be transported by the Aumund Hot Material Conveyor while still hot directly into the coke dry quenching (CDQ). Direct charging of the CDQ is to a large extent continuous, with the advantage that the buffer zones of the CDQ, and therefore the investment costs, can be reduced considerably, and if the CENTREX® Discharge System is used, the building height can be lower.

Charging of the **blast furnace** can, under the right conditions, be carried out by selected Aumund conveyors, which means that for example compact blast furnace plants can be realised, or an existing skip conveyor can be replaced when upgrading. The input materials can then be charged at high temperatures if required.

| Aumund

**Zumbach**  
SWISS PRIME MEASURING SINCE 1957



## 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



**4 - 8**

Number of cameras



**5**

Min. object diameter (mm)



**720**

Max. object diameter (mm)

## AUTOMATION

# Lasers analyse slab heating furnaces molecule by molecule

At Tata Steel UK digitally fired furnaces have been equipped with an innovative laser technology, which will improve product quality and consistency while further cutting the site's energy use and carbon footprint

The two slab reheating furnaces at Tata Steel's hot rolling mill in Port Talbot are probably the first digitally fired furnaces in the world to use an innovative laser technology, which will improve product quality and consistency while further cutting the site's energy use and carbon footprint. This ground-breaking work was the brainchild of Tata Steel Process Technologist, Jonathan Richards, who worked with one of the market leading technology companies, OnPoint Digital Solutions, LLC, a Koch Engineered Solutions company to perfect the energy-efficient solution.

Jon explained: "Heating slabs to the correct temperature is critical to ensure the metallurgical properties match the requirement of our customers. Not only that, but with a system that allows us to

monitor and control our use of gases more accurately, we can save energy, save costs and reduce our carbon footprint. We've installed laser sensors, which measure – at a molecular level – the combustion products and the temperature profile of the furnace to produce live visual data. As beams of light pass through the furnace atmosphere, carbon monoxide, water vapour and oxygen absorb the light. It is this light loss that indicates the volume of each constituent molecule. From the percentage of each molecule, we can infer the combustion efficiency of the furnace."

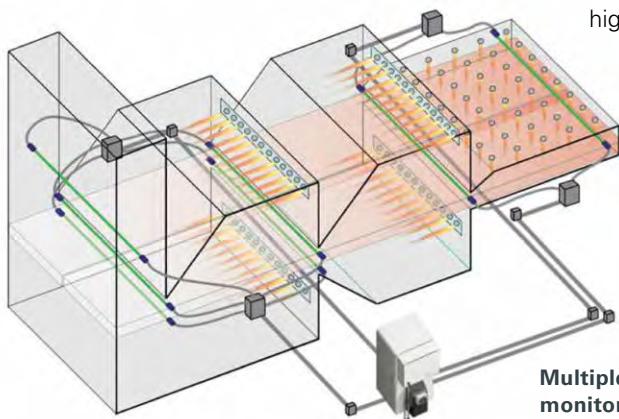
Jon continued: "If there is too much air, the furnace will cool leading to increased gas consumption as the furnace fires harder to achieve the right temperatures. Excess air also increases yield losses through oxidation. Excess fuel levels lead to incomplete combustion, producing high levels of carbon monoxide and the unburned fuel is wasted."

OnPoint's ZoloSCAN™ technology delivers unique laser-based combustion monitoring and diagnostic capabilities for ultra-harsh environments to optimize the

yield, efficiency, and safety of combustion applications. Eight laser paths are strategically placed on each furnace to measure the combustion gases zonally above and below the steel slabs as they move through the furnace and heat to the optimal temperature.

The new technology can help narrow down issues to any of the 56 burners in each furnace; accurate burner performance will lead to more efficient planning ahead of maintenance stops, cleaning, and calibrations. David Brinkmann, Service Manager and Engineer from OnPoint added: "It has been a great opportunity to work with Tata Steel on this project, as we know the benefits that companies can get from our ZoloSCAN™ laser technology. More and more we are seeing the huge advantages of such collaborations in high-tech industries such as steel."

The next phase of the project is to make the process a closed loop operation with the system detecting anomalies and automatically adjusting the furnace gas flows to ensure optimum energy efficiencies. Jon said: "This has been a remarkably successful project. Our energy usage has fallen dramatically and this work has helped the business reduce more of its carbon footprint."



**Multiple zone, laser-based combustion monitoring system** (Picture: Tata Steel UK)

■ Tata Steel UK

## Slab-reheating furnaces at Tata Steel's Port Talbot site

Two furnaces heat the steel slabs – each weighing around 30 tonnes – up to 1,200°C before they are rolled into steel strip. The furnaces are fuelled by around 60% natural gas supplemented with around 40% process gases from the coke ovens.

Each reheat furnace is 55 metres long, has 56 gas burners, and holds up to 80 slabs at any one time. The Port Talbot site is around 81% energy self-sufficient, using gases from its blast furnaces, steel plant and coke ovens to generate heat and electricity through its on-site power plant.



Dia. 1,200 mm round bloom casting at Jiangsu YongGang (Picture: Danieli)

## BLOOMS FOR OPEN-DIE FORGING

# CFHI opts for the record-breaking caster to produce dia. 1,600 mm blooms

Two-strand, semi-continuous vertical caster to produce the most competitive, jumbo-sized special steel grades

Quality, productivity, and competitiveness are the basis of China First Heavy Industries – CFHI strategy for the production of 1,350-mm and 1,600-mm-dia. rounds for special steel grades for forging applications. Hence the choice of a new, technologically advanced, Danieli semi-continuous vertical caster will be installed in the Fulaerji manufacturing base, Qiqiha'er city, Heilongjiang, China.

Danieli semi-continuous casting makes use of water-cooled copper moulds, hydraulic oscillating tables, Danieli Rotelec Electro-Magnetic Stirrers (EMS) and induction heating systems. The process doesn't require in-line oxy-cutting, with blooms standing in a vertical position until complete solidification. With variable lengths up to 12.5 m, blooms can have

weights ranging from 100 to 180 tons, according to the steel tapped in the ladle.

Danieli semi-continuous casting allows the use of a movable dynamic EMS system along the bloom length during solidification, which is not possible with conventional ingot route due to the use of cast-iron molds. Also, induction heating will be used on the bloom tail, at the casting end, to reduce the shrinkage cavity, optimizing bloom yield.

By operating this new Danieli casting technology and equipment, CFHI will be able to produce jumbo blooms with a high-quality internal structure high internal soundness and excellent surface quality at higher productivity and safety compared to the conventional ingot casting route, and its dirty, wide working areas with dan-

gerous operating procedures. The plant is scheduled to start production by end of 2023.

CFHI is a state-owned, Chinese high-tech enterprise with full-coverage manufacturing capacity for nuclear power equipment, and the largest supplier of hydrogenation reactors for oil refining in the world. CFHI produces by itself the high-quality steel required by many demanding applications. In 2022, Danieli successfully commissioned two continuous-casting machines, at Jiangsu Yonggang and Chengde Jianlong Special Steel, in China, for continuously cast blooms up to diameter 1,200 mm.

| Danieli

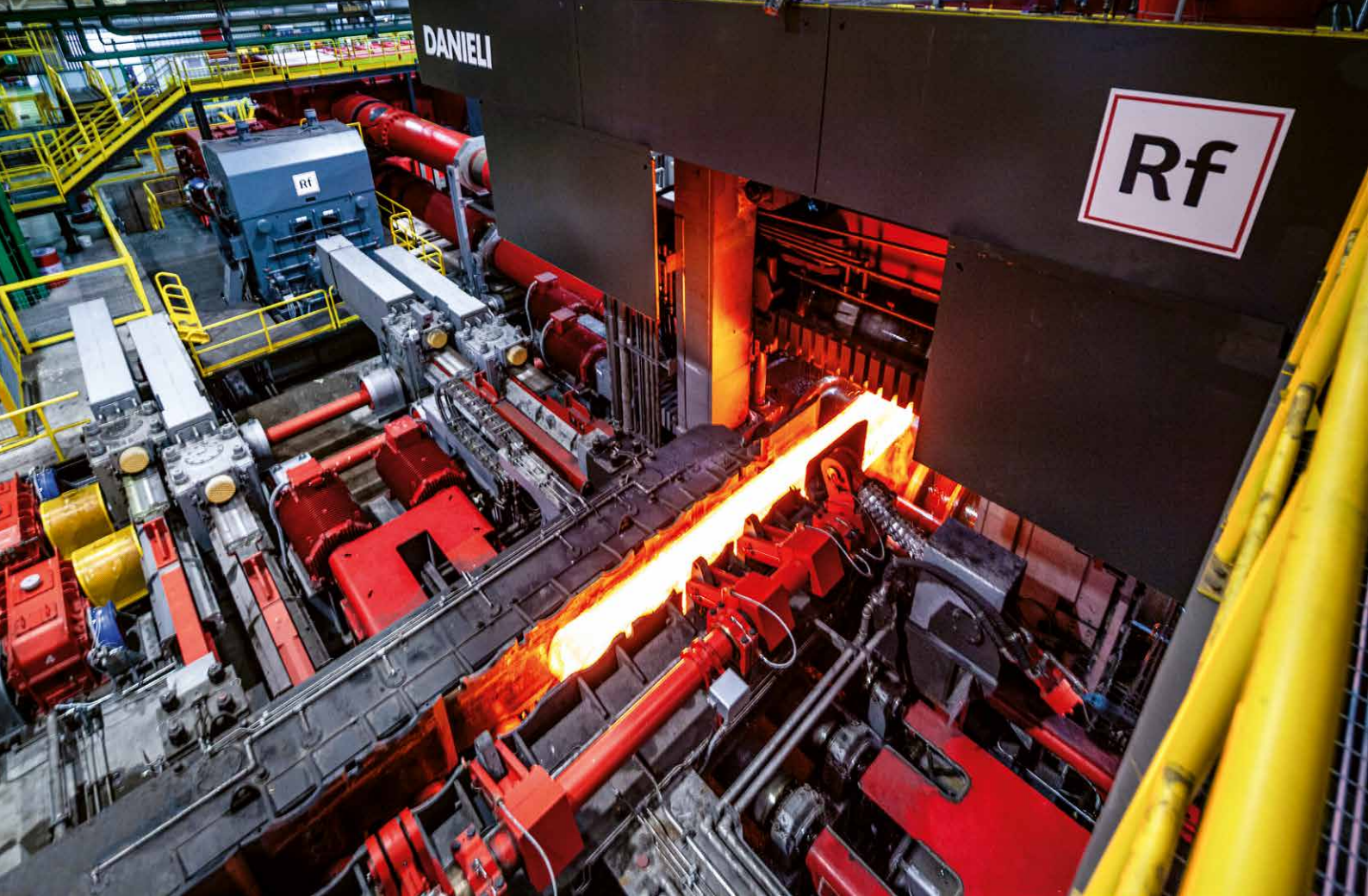


Figure 1. Special steel long-product manufacturer ABS was first to operate a Rotoforge plant (Picture: Danieli)

## HIGH QUALITY EFFICIENT AND COMPETITIVE PRODUCED

# Rotoforged bars for the energy, automotive, nuclear and oil and gas sectors

Danieli Rotoforge “RF” is an ideal alternative solution to the production of high-quality material by way of the forging route. Combining the best of rolling and forging processes, the heavy-duty Danieli Rotoforge delivers large-size SBQ bars with the same internal soundness found in materials produced by a forging process, but at much higher productivity. When combined with a jumbo-size caster – which is the natural technological match – Rotoforge allows for unbeatable productivity, efficiency and safety of high-quality big-bar production.

The use of large, SBQ rolled bars is necessary whenever the mechanical and metallurgical characteristics are not available from the use of just cast products. A reduction ratio and internal soundness and surface quality are needed to satisfy the final use requirements.

The replacement of cast long products with large-size rolled bars led to larger size equipment requirement and process adjustments for the production of round and square bars greater than 250-mm-dia.

Such rolled products, produced in different dimensions and steel grades are used for a wide range of applications that can be summarised as per most significant use:

Bars Ø > 400 mm:

- › wind sector and power generator (18CrNiMo7.6).
- › gearboxes (42CrMo4); flanges and bearings.
- › oil & gas AISI 4130 (30CrMo4) and AISI 410 (with high Cr)

› mining and construction machinery for shaft and wheels (34CrNiMo6).

Bars Ø 230-400 mm in addition to the above there are:

- › crankshafts, traction gears, axles for railway sector
- › cylinders and pressure cylinders
- › industrial and mechanical application

Bars Ø 110-260 mm:

- › trucks and agricultural vehicles (toothed crowns, pinion, crankshafts and other molding parts)

- › construction machinery (half rollers, meshes, shaft etc.)
- › industrial and mechanical application

**Rotoforge mill, the Danieli answer to market request**

Based on the presented product range and the high-quality requested by the market, it is proven by facts that the Danieli Rotoforge “RF” is an ideal alternative solution to the production of high-quality material through the forging route. In fact, thanks to the RF heavy-duty stand design that imparts the same tensile strength to the core of the bloom, Rotoforge produces products with the same internal soundness found in materials produced by a forging process, but at much higher productivity.

Different type of feedstocks are normally considered for the production of big bars, such as rectangular, square and round blooms, and ingots.

Rectangular and square blooms produced by coticasters give great flexibility.

Round blooms from continuous casting offer more uniform metallurgical structure and fewer defects typical of blooms, such as cracks on the edges and internal segregation.

Ingots in various sizes and shapes (rectangular, polygonal, etc.) are used for high-alloyed steels products, and when a strong reduction between the feedstock and the final product is required.

Given the growing demand for final products larger than 300-mm-dia, and reduction ratios higher than 4:1 (typical of quality carbon steels), it is clear that larger and larger cast products are required.

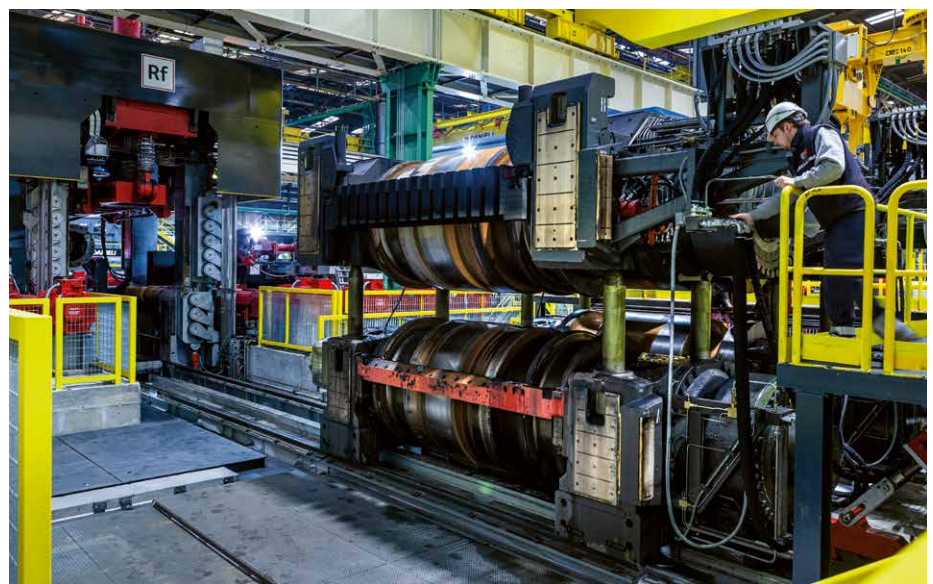
Rotoforge offers remarkable advantages to forged products, combining the best features of both rolling and forging technologies:

- › high internal quality, comparable to a forged product,
- › improved size tolerances and quality,
- › high reduction ratio for the entire product range (>1:3) for rounds up to 500 mm and equivalent square,
- › high productivity,
- › short lead-time and fast response to market demand.

The solution outlined by Danieli required a rolling stand capable of imparting to the material the same strain “to the core” that is applied by a forge. As a result of the high degree of drafting on each pass, “rotoforged” material has a fine grain size and



**Figure 2. The rolling team can supervise the plant using an advanced operator interface** (Picture: Danieli)



**Figure 3. Two-high reversible stands pursue maximum flexibility in terms of production and quick changing times** (Picture: Danieli)

very low soundness (FBH < 2 mm), while the rolling process ensures excellent surface characteristics, high productivity, and hence a dramatic reduction in transformation costs (no additional machining is required).

Moreover, during the “rotoforging” process the bar is rotated at every pass (as in the forging process) to increase the isotropic grain characteristics of the final product.

To achieve a competitive production of such large SBO products, minimize the

investment costs and quicken the return on investment, ABS and Danieli decided to install the Rotoforge stand upstream of the two reversible stands already in operation.

This idea gave rise to a new challenge: a rolling mill with three two-high reversible stands, pursuing maximum flexibility in terms of production and quick changing times – all very important features for a SBO mill, where production lots are small and require frequent stand changes. Please see the chapter “The Rotoforge plant at ABS”.



**Mechanical characteristics**

The results are visually presented by the comparison of macroetches and ASTM grain size achieved by forged, rolled, and rotoforged processes. The macro-etching results of big round and square bars, ranging from 250 to 350 mm, obtained by rotoforging process are reported in the pictures summarized in **figure 4**. Each macro-etch on finished product is compared to the related starting cast feedstock, so that the grain refinement effect by rotoforging can be appreciated.

Macrographs reveal a comparison on ASTM grain size results among three different production processes in ABS: rolling (with conventional stands), rotoforging, and forging (**figure 5**). Grain size is compared in three zones of the cross section of the finished bar: surface, 1/2 radius and core.

The results on 1/2 radius and core from rotoforging (grain size 3) are comparable to results from forging (4), and the situation is hugely better than conventional rolling (negative grain size).

The grain size diagram (**figure 6**) is plotted in three zones of the cross section of the finished bar: surface, 1/2 radius and core. The results on 1/2 radius and core from rotoforging nearly identical to forging, and hugely better than conventional rolling

(negative grain size). The bars are on medium carbon 4140 steel, obtained by cast feedstocks with a reduction ration (RR) about 4:1.

**Finishing services.** The first operation after hot rolling is cutting-to-length, and to do this efficiently Danieli has designed a fast disk-saw for big bar mills characterized by a very quick cutting cycle. The true cutting time is around 1 sec for a 500 mm round (+50 sec for the flywheel loading). Compared to conventional oxy-cutting, the productivity increases three times, the cutting surface improves, and less conditioning is required downstream. The saw-disk lifetime as well is about four times longer than a conventional saw, reducing planned downtimes to replace disks.

Before entering the finishing area where operations are executed at temperatures below 80°C, big bars have to be cooled down. A water spray box is installed at cooling bed exit to cool the bar layers down to the required temperature before entering the shot blasting machine, to remove the ferric-oxide layer on the surface of the hot rolled bars. Thanks to this process the bars will be delivered with a finishing degree of SA 3 and a roughness of less than Ra 10.

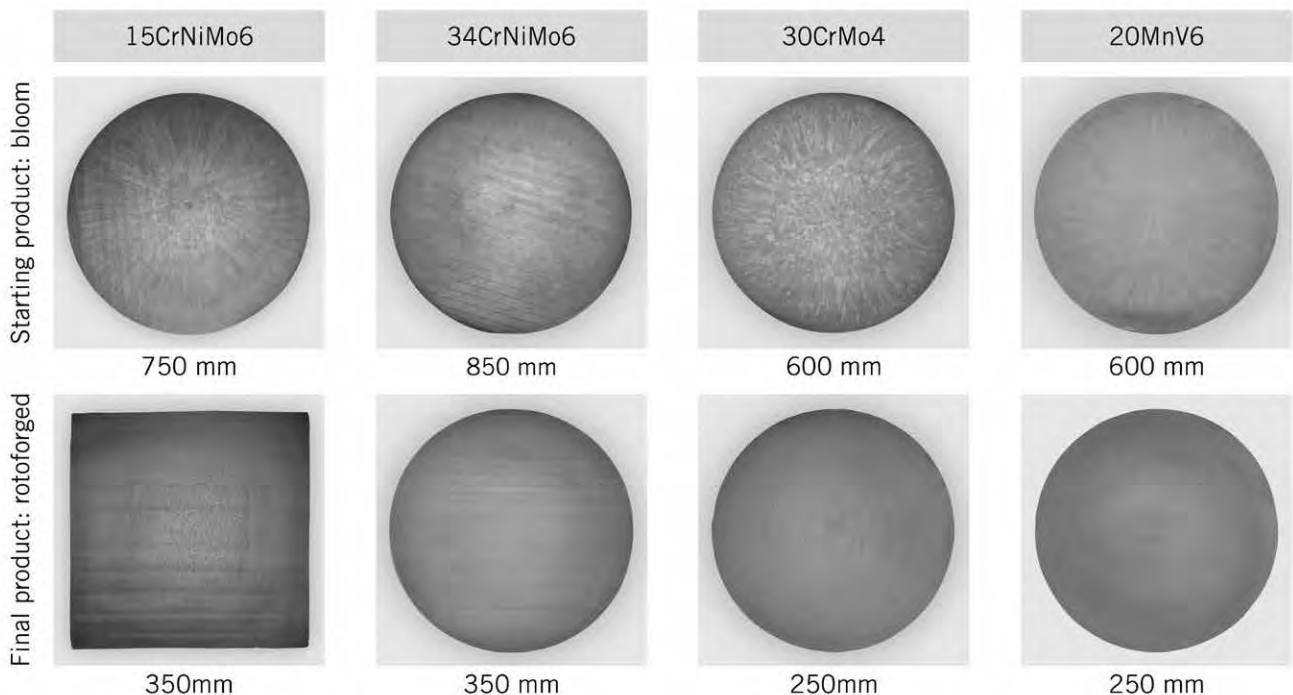
To eliminate any possible burrs left on the bar-ends after cutting to length, bars

are processed in the chamfering station, to prevent damage to the heads of the Non-Destructive Testing (NDT) center and facilitate the subsequent peeling process.

After chamfering, bars are conveyed to the NDT center to detect the presence of surface and internal defects. Surface inspection is performed by Eddy Current technology on round bars and square bars, including corners. Testing for internal defects is done by ultrasonic technology with conventional probes in longitudinal wave mode, immersed in a tank with a floating probe holder. Defect location is revealed by means of an ink spray marker.

The NDT station is situated on a line parallel to the main one, so the bars can be diverted into the station or can bypass it and continue to the final preparation area. At the exit side of the NDT station the bars can be rejected or transferred to the repairing station for manual spot grinding or manual cutting with carbide disc saws.

Stacking of large-size SBQ bars is performed with a non-magnetic system, fitted with a series of lances that pick up the layer of bars from the feeding chain transfer and deposit it into the forming pockets. The pockets are equipped with gradually lowering arms that descend step-by-step as each layer is deposited. After formation, stacks are automatically weighed,



**Figure 4. Internal soundness – macroetch of cast and rotoforged finished products** (Picture: Danieli)

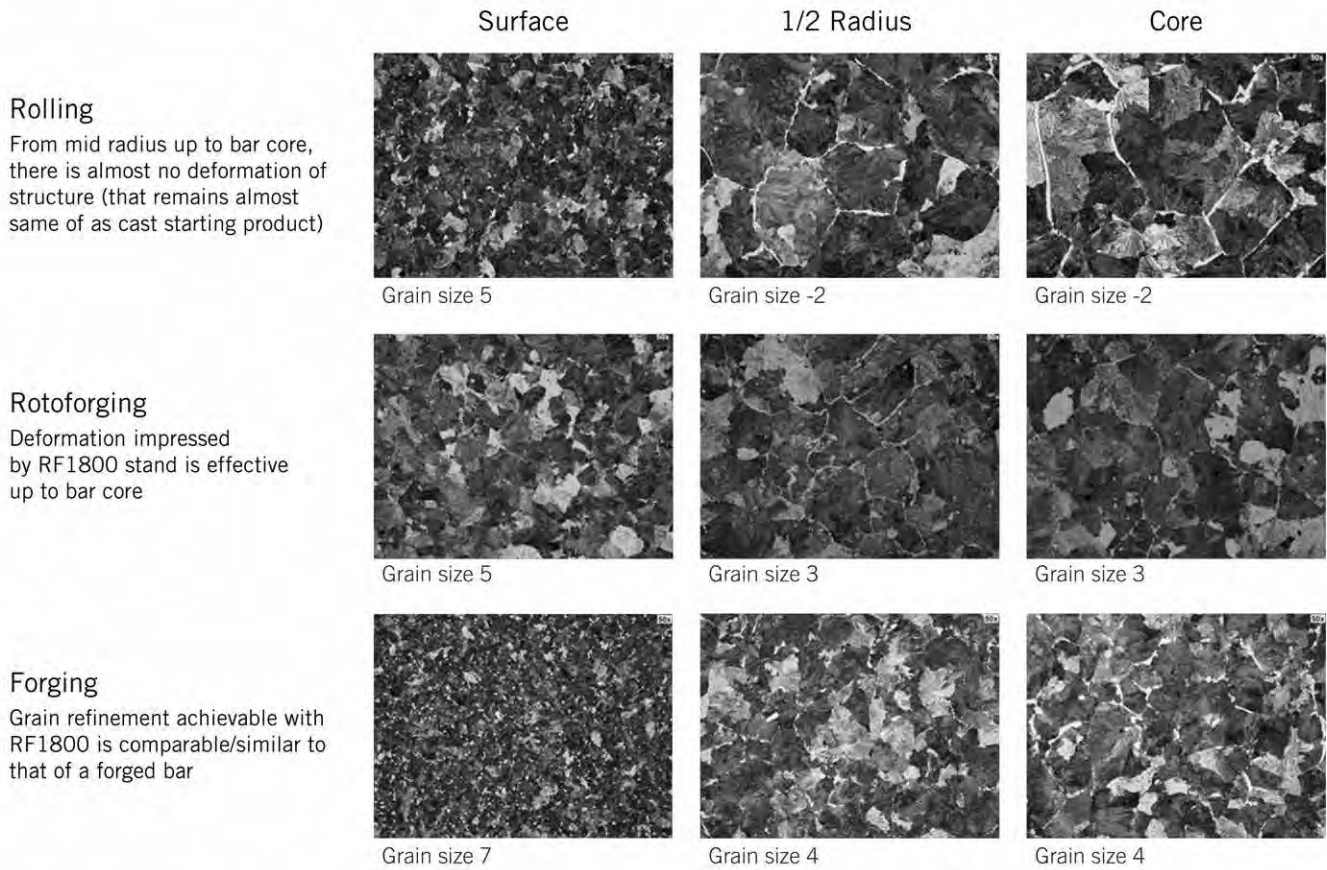


Figure 5. Comparison among different ABS continuous processes (Picture: Danieli)

... tied, and conveyed to the final collecting station. A tag is produced with the order information and applied automatically to the stack and the final products are ready for the truck.

**Process control, automation and Q3-Intelligence.** Considering the need of high flexibility in operation and quick response to market demand, Danieli Automation process control and equipment play a fundamental role in ensuring fast and effective machine set up for quality production. Production is organized based on short-term production scheduling.

Mathematical models and advanced supervisory functions are designed to operate the entire production line including the Rotoforge in fully automatic mode, with the right rolling-pass schedule and rolling sequences to achieve the dimensional and quality results expected for the scheduled production.

Each produced piece is tracked, as well as the relevant quality characteristics.

The rolling team can supervise the plant using an advanced operator interface system designed to actively interact when an

operator intervention is needed because of anomalies or human decision-making needs, adopting object-based techniques and intuitive point and click operations.

All plant data are collected in a centralized data repository for reporting and for data analytics, using the powerful tools of Danieli Automation Q3-Intelligence, also

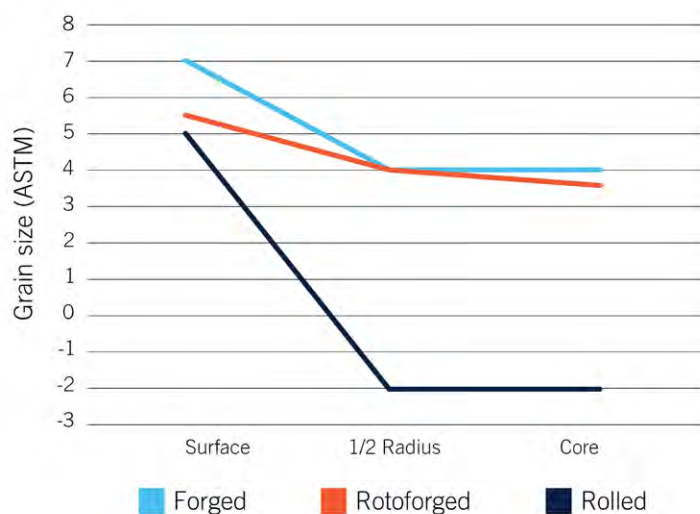


Figure 6. Grain sizes (ASTM) of rotoforged, rolled, forged ferritic bars (4140 steel grade) (Picture: Danieli)

providing machine learning possibilities to solve quality and process issues.

Monitoring is performed thanks to customizable web reports distributed to selected entities to control and identify the plant performance indicators.

Historical information is browsed using powerful analytics to support strategic decision-making, quality increases, efficiency and productivity.

Collected data can be further explored with predictive tools and machine learning for temperature, quality, and alarm prediction, just to mention possible solutions.

The final achievement of the system is to optimize setup time for sequences, minimizing out of specification products and reducing downtimes.

The mill main motors are driven by the Danieli Q-Drives, specifically designed for the steel industry with focus on reliability and easy maintainability.

**The Rotoforge plant at ABS**

Special steel long-product producer ABS was first to operate a Rotoforge plant. The Rotoforge plant was started up in September 2015 at ABS in Cagnacco, Italy, and after a smooth hot test run it entered industrial operation. There, Rotoforge is fed with high-quality, Ø-850-mm blooms having excellent surface quality even for products with critical carbon content of 0.15-0.20%, low internal segregation on the whole product mix, up to 1% of carbon content, produced by the nearby CCM #3 continuous casting machine, and ingots.

The installation of the Rotoforge was the most important event within a wide upgrading project of ABS big bar plant, named Marte. The Marte project started in 2013 with step-by-step replacement of

the “800”reversible mill, and continued with the new, “1000” blooming mill the following year.

Still in 2014, the “Hercules” CCM #3 bloom coticaster, which was producing 650-mm-dia blooms, was revamped to produce round blooms up to Ø 850 mm – the world-largest coticast section at that time.

The last step was the implementation of a new reheating furnace and the Rotoforge, with installation executed without stopping the plant other than during the scheduled yearly maintenance shutdowns. This enabled ABS in to produce big bars with outstanding quality characteristics.

“Rf13” and “Rf16” ingots (790-915-mm side up to 13.5 t, and 850-1000-mm side up to 15.8 t) were cast, with a shape developed for the rolling by the Rotoforge, and to ensure a minimum reduction ratio of 1:3.6 for Ø-500-mm rounds. The Rotoforge mill can roll blooms and ingots starting feedstock with max. diameter or side up to 850 mm.

The layout of Marte plant was developed to maximize the flexibility of operation:

- › Cast blooms are heated at a rate of 100 t per hour (cold charge) in a Danieli Centro Combustion walking-beam reheating furnace, with the possibility of hot charging directly from CCM #3.
- › Ingots are heated in six pit-furnaces directly connected to the Rotoforge via a transport trolley.
- › The three reversible stands are arranged “in cascade”, each one specialized in finishing a set range of rounds and equivalent squares: round 110-230 mm (800 reversible mill), round 230-405 mm (1000 blooming mill), round 360-500 mm (Rotoforge), ensuring the best final product achievable in terms of quality and tolerances.

All new stands operate in fully automatic rolling mode, connected to a higher level of automation enabling the introduction of control algorithms that make the process steady and repeatable, with benefits for head and tail deviation and bar straightness.

Also, the three stands feature hydraulic capsules installed in all the bottom rolls and a flexible in-line adjustment system of rolls and guides that guarantee perfect rolling setup. The rolling guides are designed to be removed together with the roll chocks through the stand housing, to further reduce roll-change operation time.

Downstream the rolling mill stands, after cutting, the big bars follow different cooling routes according to dimensions. Conventional cooling is adapted for products Ø 260-500 mm, whilst controlled cooling with insulated cooling bed is reserved for other product dimensions down to Ø 110 mm.

The insulating cooling bed design allows for conventional cooling or slow cooling according to the final application. Thanks to the adjustable insulation hoods, cooling rates can be adjusted according to the distance between hoods and the products, to improve the shareability and reduce the hardness.

Another important concept of the Marte plant upgrade was to put in-line all the finishing operations for rounds up to Ø 260 mm, that is the greatest product-mix range requested by the market. For those, quenching, sand-blasting, chamfering, non-destructive testing, stacking and binding are performed in-line, to deliver to the discharge table a final product ready-for-the-truck.

**Conclusion**

Since the introduction of the Rotoforge, ABS has been supplying products with extremely high mechanical performance, metallurgical characteristics, and improved tolerances/straightness. ABS is strongly committed to continuous improvement to maintain its leadership in the SBQ sector, and to provide a tailored service to satisfy every customer’s needs. The Rotoforge investment has been allowing the company to operate with a technology edge on the competitors.

▮ *Danieli Morgardshåmmar, Matteo Dovigo – Contact: m.dovigo@danieli.it*

**Table 1. While ensuring the same metallurgical characteristics, Rotoforge achieves largely higher productivity and material yield than forging**

	Forging	Rotoforging
Draft per pass	↑	↑
Reduction ratio	↑	↑
Grain size	Fine	Fine
Soundness	FBH < 2 mm	FBH < 2 mm
Productivity	↓	↑
Material yield	↓	↑

## Design study for an electric smelting furnace pilot

The facility will aim to demonstrate a pathway to lower carbon dioxide (CO<sub>2</sub>) intensity in steel production using iron ore from the Pilbara mines in Australia.

International mining company BHP and global engineering, project management and professional services firm Hatch, have signed an agreement to design an electric smelting furnace (ESF) pilot plant in support of a decision to construct this facility in Australia. The small-scale demonstration plant would be used to collaborate with steel producers and technology providers to generate and share learnings with the aim of accelerating scale up of ESF plant designs.

The pilot facility would be intended to test and optimise production of iron from the ESF, a new type of furnace that is being developed by leading steel producers and technology companies targeting low CO<sub>2</sub> emission-intensity steel. The ESF is capable of producing steel from iron ore using renewable electricity and hydrogen replacing coking coal, when combined with a direct reduced iron (DRI) step. Estimates show that reductions of more than 80 per cent in CO<sub>2</sub> emission intensity are potentially achievable processing Pilbara iron ores through a DRI-ESF pathway, compared with the current industry average for the conventional blast furnace steel route.

The ESF allows for greater flexibility in input raw materials, addressing a key barrier to wider adoption of other lower CO<sub>2</sub> emissions production routes, such as use of electric arc furnaces which are designed for scrap steel and high grade DRI only. The ESF also has the potential to be integrated into a steel plant's existing downstream production units.

The pilot facility will enable deeper and more accurate insights into the performance of this technology for converting iron ores into molten iron and steel. Planned test programs will help de-risk further investment in commercial scale projects, thereby complementing development plans of BHP's steel customers. This scale-up approach has been utilised by other industry demonstrations such as Sweden's HYBRIT project.

BHP's Chief Commercial Officer, Vandita Pant, said: "We see the ESF process as a critical breakthrough in significantly reducing the carbon emissions intensity of steel production and one that provides an opportunity for iron ore from our Pilbara mines. The steel industry has identified the ESF as a viable option to use a wider range of raw materials and steel companies globally are looking to build commercial-scale ESF plants as part of their CO<sub>2</sub> emission reduction roadmaps."

BHP and Hatch will assess several locations in Australia for the proposed facility based on supporting infrastructure, technology skills and the availability of local partnerships to build and operate the facility.

| BHP/Hatch

# Pneumatic Conveying, Dosing and Injection Systems

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Gunning

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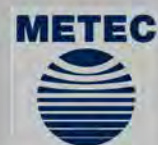
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# Perfectly flat AHSS sheets free of internal stresses

ArcelorMittal Downstream Solutions Poland (AMDS) has incorporated new stretch-levelling equipment in its Kraków Steel Service Centre which can provide customers with perfectly flat sheets of Armstrong®. These advanced high strength steels (AHSS) have a range of applications in products used in the manufacture of yellow and green goods, railway equipment, and machinery.

The investment at AMDS Kraków will provide best-in-class flatness to steel processors who rely on fully automatic laser-production lines to process the Armstrong® grades. To operate successfully, these lines require AHSS material which is perfectly flat and free of the internal stresses which are typically generated during rolling operations. Market demand for ultra-flat products is expected to boom in the coming years, particularly in the Eastern European region.

**Automated laser cutting possible**

“Our existing line meets the needs of around 98 percent of our customers in terms of flatness,” notes Rafal Nawrat, CEO of ArcelorMittal’s Steel Service Centres in Poland. “But this is not flat enough for automated laser and plasma cutting lines. These customers require a guarantee that the sheets have a maximum deviation of just three millimetres per metre of material. With the new stretch levelling line, we can make that guarantee.”

Customers require a guarantee that the AHSS sheets have a maximum deviation of just three millimetres per metre of material. With the new stretch levelling line, we can make that guarantee.

*Rafal Nawrat, CEO of ArcelorMittal’s Steel Service Centres in Poland*

The technology measures the waviness of the steel as it enters the stretch levelling line. “Depending on the result of that measurement, the line will choose whether the coil will be rolled using a standard roll leveller, or the stretch leveller,” explains Kamil Pyzynski, Engineer at AMDS Poland. “The stretch leveller is slower, but guarantees that the material

will be below the waviness threshold required by automated cutting lines.”

As well as the stretch leveller, the line includes tools which measure the geometry of the steel sheet and the internal stress in the steel. “All three parts are connected through the line control system,” says Kamil Pyzynski. “This enables us to correct edge waviness and reduce the



From left to right: Rafal Nawrat, CEO of ArcelorMittal’s Steel Service Centres in Poland, Urszula Dzierzon, Head of Distribution for AMDS Poland and Kamil Pyzynski, Engineer at AMDS Poland (Picture: Kamil Pyzynski/ArcelorMittal)



AMDS Kraków can produce Armstrong® sheets with a maximum deviation of just three millimetres per metre (Picture: Kamil Pyzynski/ ArcelorMittal)

stress within the steel through plasticisation. The result is an AHSS sheet which can be used on automated lines without disrupting the customer’s production flow.”

**Armstrong® properties unaffected**

The mechanical properties of the Armstrong® steel are not affected explains Urszula Dzierzon, Head of Distribution for AMDS Poland: “Like all Armstrong® grades, the material maintains good formability and excellent weldability, even after stretch levelling. We have tested the material in an accredited laboratory both before

and after levelling. The laboratory has confirmed that there is no statistically significant impact on the steel’s mechanical properties.”

“As Western Europe Service Centres already propose the Armstrong® laser in their portfolio, with our investment in Kraków we ensure that any customer in Europe can easily access to perfectly flat sheets of ArcelorMittal Armstrong® steels” says Rafal Nawrat.

**Demand ramping up**

Customer response to the stretch leveller implementation has already been signifi-

cant notes Urszula Dzierzon: “Our customers have been requesting perfectly flat AHSS for some time as it allows faster processing and less disruption to automated cutting lines. With the commissioning of the stretch levelling line in Kraków we are now able to meet these requests. In initial trials customers have been very impressed by the material and we expect our order book to fill quickly during 2023.”

The investment in the stretch levelling line was made possible due to a grant from the EU.

█ ArcelorMittal Europe Flat Products



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**HIGH STANDARDS AND MAXIMUM TRANSPARENCY**

# Emissions reduction certificates help reducing the carbon footprint

Despite many innovations and efforts, it is not yet possible for companies today to completely avoid CO<sub>2</sub> emissions or reduce them to zero. This applies in particular to so-called Scope 3, where emissions are generated in the supply chain or through the use of the products sold. With so-called Voluntary Carbon Credits companies can offset emissions along their own value chain and contribute to achieving climate targets.

**We clearly see the need for sustainable solutions that take effect immediately. That's why, in addition to CO<sub>2</sub>-reduced products, we also offer the purchase of voluntary carbon credits.**

*Martin Stillger, CEO of thyssenkrupp Materials Services*

of the atmosphere or a vent, compressing it into rock layers and storing it in mine tunnels, for example. The portfolio also includes biochar projects. Biochar is a process in which biomass is compressed under extreme heat so that no CO<sub>2</sub> can escape. The resulting product is used as a plant fertilizer, for example.

Emissions that are harmful to the climate may only be offset and thus retired once. It is therefore crucial that the process is transparent and recorded in accessible registers to ensure that emission values are assigned to specific VCCs. A prerequisite for offsetting is knowledge of one's own CO<sub>2</sub> footprint. At thyssenkrupp Materials Services this is achieved with the "Product Carbon Footprint Calculator" introduced in 2022. This calculator measures all emissions along a product's supply

**T**hyssenkrupp Materials Services, one of the leading mill-independent materials distributors and service providers in the Western world, claims to be the first company in its sector to offer Voluntary Carbon Credits (VCCs). "Our ambition is to offer our customers the best products and solutions to help them achieve their sustainability goals," says Martin Stillger, CEO of thyssenkrupp Materials Services. "We clearly see the need for sustainable solutions that take effect immediately. That's why, in addition to CO<sub>2</sub>-reduced products, we also offer our customers the purchase of voluntary carbon credits – and all from a single source, from the supplier they trust."

The certificates are selected in accordance with careful criteria that must be reviewed and developed continuously. In addition, coordination takes place with the customers regarding their wishes. When selecting projects, the question of whether they are sustainable and accompanied by additional measures plays a critical role. Examples of such projects include

reforestation, expansion of drinking water supplies and direct air capture carbon and storage. This involves extracting CO<sub>2</sub> out



**Martin Stillger, CEO of thyssenkrupp Materials Services, sees the need for sustainable solutions that take effect immediately** (Picture: thyssenkrupp)

chain and thus provides clarity on the status quo. The aim is for these emissions to also be offset directly via VCCs in the future.

### Voluntary carbon credit desk

The VCC Desk at thyssenkrupp Materials Trading handles the careful selection, procurement and transparent and orderly retirement of emission reduction certificates centrally for thyssenkrupp Materials Services and for its own customers. The resulting offset is relevant both for the

company's own emissions (company carbon footprint) and for emissions in connection with the customer's trading products (product carbon footprint).

"With the VCC Desk, we relieve customers of an often complicated, labor-intensive and administrative process and make it easier for them to access the voluntary carbon credit market with expert support," said Wolfgang Schnittker, CEO of thyssenkrupp Materials Trading. "The VCC Desk will gradually enable all of thyssenkrupp Materials Services customers as well as external companies to purchase

emission reduction certificates and retire them. With CO<sub>2</sub> prices and continuously increasing legal requirements, saving CO<sub>2</sub> emissions will become an economic necessity in the coming years."

The VCC Desk is part of thyssenkrupp Materials Services' sustainability strategy BEYOND, which is based on internationally recognized ESG criteria but goes beyond legal requirements and standards – hence BEYOND.

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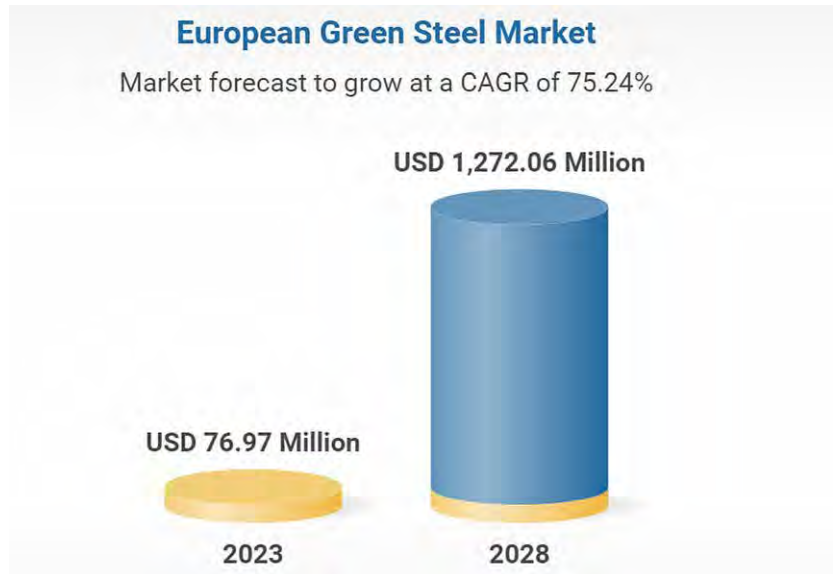
## EUROPE

### European green steel market analysis 2023

The European market for green steel is expected to see growth in the future as European steelmaking companies, such as Germany’s thyssenkrupp and Arcelor-Mittal, are looking at using hydrogen to replace coking coal.

According to a report published by Research and Markets, the outlook for green steel demand has positively surprised over recent years with a broader mix of end users than initially expected. It can be observed that demand for green steel has expanded to many more end markets than initially expected. Demand for green steel is ultimately led by a combination of two key drivers: Scope 3 emissions reduction targets and end consumer demand. The Europe green steel market is projected to grow at a CAGR of 75.24% during the forecast period of 2023-2028. In 2022, it was valued at US\$ 47.36 million, and is probable to reach US\$ 1,272.06 million by 2028.

In 2021, SSAB delivered the first batch of steel made using ‘green’ hydrogen to an automobile manufacturer for truck production. Demand for green steel is increasing and technologies continue to be developed as the industry moves towards decarbonization and a more sustainable future. Higher cost of production is a major challenge facing the green steel market. For example, green steel production often involves using recycled steel scrap as raw



Forecast of green steel market in Europe (Picture: Research and Markets)

material, which is more expensive than using virgin iron ore. The complexity of carbon accounting calculation and the energy crisis have been named as other challenges.

A major trend gaining pace in green steel market is increasing investment in launching green field projects. Market players are increasingly investing in launching green field projects, and building partnerships and strategic alliances to transform their businesses in green steel is driving the market.

About two thirds of the green steel projects are in Europe, where also the largest investments occur. According to the report, the automotive segment acquired majority of share in the market in 2022, as green steel is now being used by automakers to ensure a cleaner, greener manufacturing ecosystem. Europe green steel market is concentrated with SSAB, Salzgitter and ArcelorMittal as best positioned, in Europe.

Research and Markets

## EUROPE

### Steel processors sign agreement with Tata Steel for lower carbon footprint steel

Tata Steel Nederland has reached new agreements with Wuppermann, Bilstein, EMW Stahl Service and Arania to supply them with lower-CO<sub>2</sub> steel.

Tata Steel Nederland aims to reduce CO<sub>2</sub> emissions by 35-40% by 2030 and be completely carbon-neutral by 2045. Across Europe, the company is implementing CO<sub>2</sub>-reducing measures at its locations, including the switch to green, hydrogen-based steelmaking at its IJmuiden steelworks.

As part of the new strategy, the Tata Steel has been offering lower CO<sub>2</sub> steel under the Zeremis brand since July 2022. The use of Zeremis® Carbon Lite by steel processors supplying major players in the automotive and industrial markets, enables their customers to make greener end products such as kitchens, robotic storage systems and passenger cars.

“Over the years, we’ve developed a collaboration with Wuppermann, BILSTEIN, EMW Stahl Service and Arania that allowed for open discussion on ways to

further reduce their Scope-3 emissions and create shared sustainability strategies. We can already supply them a significant amount of high-quality low-CO<sub>2</sub> steel now, and we aim to offer large quantities of high-quality green steel by 2030, when we target to commission our first direct reduction plants and electric furnaces at our IJmuiden site”, said Hans van den Berg, CEO of Tata Steel Nederland.

Tata Steel Europe

EUROPE

**Alusín Solar to use solar panel support structures with high-performance metallic coating**

Alusín Solar, has signed an agreement to purchase ArcelorMittal's XCarb® recycled and renewably produced steel with Magnelis® coating, a metallic coating which provides very high corrosion protection.



Pablo Avello (left), COO Finishing Asturias Cluster, shaking hands with Javier Fernández-Font Pérez, General Manager of Alusín-Solar (Photo: ArcelorMittal)

Following a major investment in galvanizing line No. 1, ArcelorMittal's plant in Avilés is now able to meet the full range of requirements for Magnelis® for the solar panel market. Alusín Solar carried our first tests on the production of solar poles using Magnelis® and will now be one of the first customers to purchase XCarb® RRP Magnelis® from the newly revamped line. ArcelorMittal provides Alusín Solar an automatic 15-year guarantee for installation in soils.

XCarb® recycled and renewably produced steel is made using 100% renewable electricity and a very high proportion of recycled steel. ArcelorMittal's Magnelis® metallic coating offers an exceptional level of surface and cut-edge protection and has a self-healing effect. The performance of Magnelis® is superior to that of galvanized steel, and it outperforms coatings containing less magnesium. Thanks to the high durability and adhesion of the coating, the steel can be shaped using different forming methods, including bending, drawing and profiling. ArcelorMittal's plant in Aviles will be able to produce XCarb® with Magnelis® coatings in thicknesses of up to 3.5 mm.

| ArcelorMittal



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## EUROPE

### Kirchhoff Automotive signs MoU with ArcelorMittal for development of low carbon-emissions products

**Kirchhoff Automotive and ArcelorMittal have signed a memorandum of understanding (MoU) that focusses on developing low carbon-emissions steel for cars and trucks.**

The agreement covers a number of different areas of development and steel solutions, but its principal focus is to strengthen the two companies' collaboration on sustainability topics. This includes a project to develop and test the use of ArcelorMittal's XCarb® recycled and renewably produced Usibor1500® (which is made with recycled steel and 100% renewable electricity) in the high-strength parts that Kirchhoff Automotive supplies to leading OEMs in Europe, Asia, and North America.

ArcelorMittal Europe – Flat Products began manufacturing XCarb® recycled and renewably produced steel at its Sestao plant in Spain more than a year ago, allowing flat steel customers to buy steel with a reduced CO<sub>2</sub> impact. The XCarb® product family will expand as the company invests in the decarbonization of the steel-making process across Europe, in line with



**Wolfgang Kirchhoff (left), CEO of Kirchhoff Automotive, and Yves Koeberlé, CEO ArcelorMittal Europe – Flat Products, signing the agreement (Photo: ArcelorMittal)**

its target to reduce CO<sub>2</sub> emissions by 35% by 2030, and to reach carbon neutrality by 2050.

■ *ArcelorMittal*

## USA

### Nucor to build new transmission tower production plant in Alabama

**Nucor's Towers & Structures business unit will build a new state-of-the-art transmission tower production plant in Decatur, Alabama. The new plant will be located adjacent to the Nucor Steel Decatur sheet steel mill.**

The plant in Alabama, which will be the first of two new tower production plants

Nucor plans to build, will be highly automated, utilizing efficient straight-line production, and include advanced hot-dip galvanizing operations.

Nucor formed its Nucor Towers & Structures business unit in 2022, when it acquired Summit Utility Structures LLC, a producer of metal poles and other steel structures for utility infrastructure. Several

factors are driving increased demand for utility infrastructure, including grid hardening, renewable energy projects, building a nationwide network of electric vehicle chargers, natural disasters and replacements, and population growth.

■ *Nucor Corporation*

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## CHALLENGING TRANSFORMATION

# Minister Mona Neubaur visits Andernach & Bleck in Germany

Mona Neubaur, Minister for Economic Affairs, Industry, Climate Protection and Energy and Deputy Minister President of the German state North Rhine-Westphalia, visited the company Andernach & Bleck in Hagen in March this year. The Minister met representatives of the family-owned steel company to discuss the current economic challenges facing the steel sector.

Andernach und Bleck is one of the hidden champions of the bright steel industry in North Rhine-Westphalia and especially in the Ruhr region. Here, the climate-neutral transformation has already been driven forward for years through innovations.

*Mona Neubaur, Minister of Economic Affairs, North Rhine-Westphalia, Germany*

Bleck explained that A&B has been already 75% decarbonised and part of a green value chain. The goal is to maintain this pioneering role and to drive real decarbonisation without buying certificates or greenwashing.

After the round of talks, the guests were given a brief insight into the plant. They were particularly interested in the drawing process for the production of bright steel.

“The medium-sized steel industry is already very far decarbonised. The final steps can only be taken if politics and business pull together. This requires an open exchange, as we were able to do today with Ms Neubaur and her speaker Dr Suveni Kreimeier,” said CEO Carsten Bleck after the meeting. For the company, the visit was a great success. They look forward to further cooperation with the Minister and her team.

■ *Andernach & Bleck*

The meeting focused on topics such as decarbonisation, energy prices and energy savings, hydrogen as an alternative and challenges for small and medium-sized enterprises (SMEs). Neubaur emphasised the importance of exchange opportunities with SMEs in order to get to know the reality on the ground and to be able to provide targeted support.

Minister of Economic Affairs Mona Neubaur: “Small and medium-sized enterprises are the backbone of the North Rhine-Westphalian economy and indispensable for growth, innovation, and jobs and apprenticeships. The major transformation tasks we are facing cannot be tackled without SMEs. That’s why I’m delighted to be able to exchange ideas with the long-established family-owned company Andernach und Bleck, which is one of the hidden champions of the bright steel industry in North Rhine-Westphalia and especially in the Ruhr region. Here, the climate-neutral transformation has already been driven forward for years through innovations.”

Andernach & Bleck took the opportunity to present their own experiences and concerns to the Minister. Together they discussed how to successfully lead the steel industry in a more climate-friendly and sustainable direction in the future. CEO Carsten



**Minister Mona Neubaur discussed with Andernach & Bleck about the transformation into a more climate-friendly and sustainable steel industry** (Picture: Andernach & Bleck)



Figure 1. EMG QA systems for SSCs clockwise: EMG iTiM, EMG iCAM®, EMG SOLID®, EMG BREIMO (Pictures: EMG)

**EMG QA SOLUTIONS FOR STEEL SERVICE CENTRES**

# Meeting the processing demands

Steel service centres (SSCs) are modern, high-performance processing companies with an extensive delivery and service programme of slit strips, sheets, and blanks of hot-rolled and cold-rolled material, surface-finished strips and special alloys. The SSCs have to master special challenges because their most important customers, the automotive companies, are facing a paradigm shift.

A decreasing share of steel in the automotive sector is expected, while at the same time the trend is towards more and more high-strength and ultra-high-strength steels with low thicknesses. The advent of e-mobility and autonomous driving are also among the challenges. To remain competitive, SSCs must differentiate themselves with the latest technologies and exceptional service, quality, agility, and flexibility.

Investments of SSCs are focused on a wide range of solutions for quality assurance and increasing production yield, as well as basic technologies for strip guid-

ing, which enable the safe operation of the various coil processing units at SSCs. In this article, the focus is on the news in EMG's quality assurance product portfolio for SSCs and steel processors.

**Quality requirements at steel service centres and processors**

The basic quality requirements of a metal processing centre refer firstly to the dimensional measurement of the strip, be it the strip thickness, the strip width as well as the corresponding properties of slit strip. Secondly defined material properties

play a major role. At this point, especially the surface characteristics of the strips to be processed are of interest. While material properties such as roughness or strength values are less frequently requested here, the importance of correct and uniform oiling is often in the foreground.

**Strip width measurement with EMG BREIMO and EMG iCAM®**

The more precisely the width can be determined for the cutting process, trimming and slitting, the more material can

be used and delivered to the end customer. EMG provides two technical solutions for strip width measurement EMG BREIMO and EMG iCAM®. While the opto-electronic system EMG BREIMO has been established in SSCs for decades, especially for uncoiling and recoiling processes, the CMOS camera-based system EMG iCAM® is a real novelty for the demanding user.

**Strip width and slit strip width measurement with EMG iCAM®**

The EMG iCAM® intelligent width measurement system is the perfect answer to these demands, which include:

- › a precise width inline measurement over the entire coil length in a scalable width range for narrow strip (< 100 mm), middle strip (100 - 600 mm) and wide strip (600 - 2200 mm),
- › the possibility to measure the width of slit strips in a range of typically 10 to 500 mm for each individual slit strip,
- › the availability of data for further analysis and customer quality assurance databases,

- › a robust and reliable measurement working uninterruptedly in long time intervals in an industrial environment.

The main components of the EMG iCAM® measuring system are shown in **figure 2**. These are the multi-camera detection unit at the top of the measuring frame and the light source – an infrared backlight unit with a scalable number of LED module units – for illuminating the entire strip width, which is integrated in the lower beam of the measuring frame. On the right is the junction box with the signal light and below the strip pass-line two transfer boards for strip protection are located. The advantages of the EMG iCAM® are as following:

- › no sensitivity to external light sources,
- › width measurement of slit strip/s.

Selected technical data are as following:

- › strip width range: 300 - 2,800 mm
- › measuring gap: typically, 500 mm
- › LED IR wavelength: 850 nm (influence of extraneous light sources)
- › measuring accuracy: ± 0.1 mm
- › allowed passline variation: 19 mm

In summary, it can be stated, that EMG iCAM® fully meets the extended user

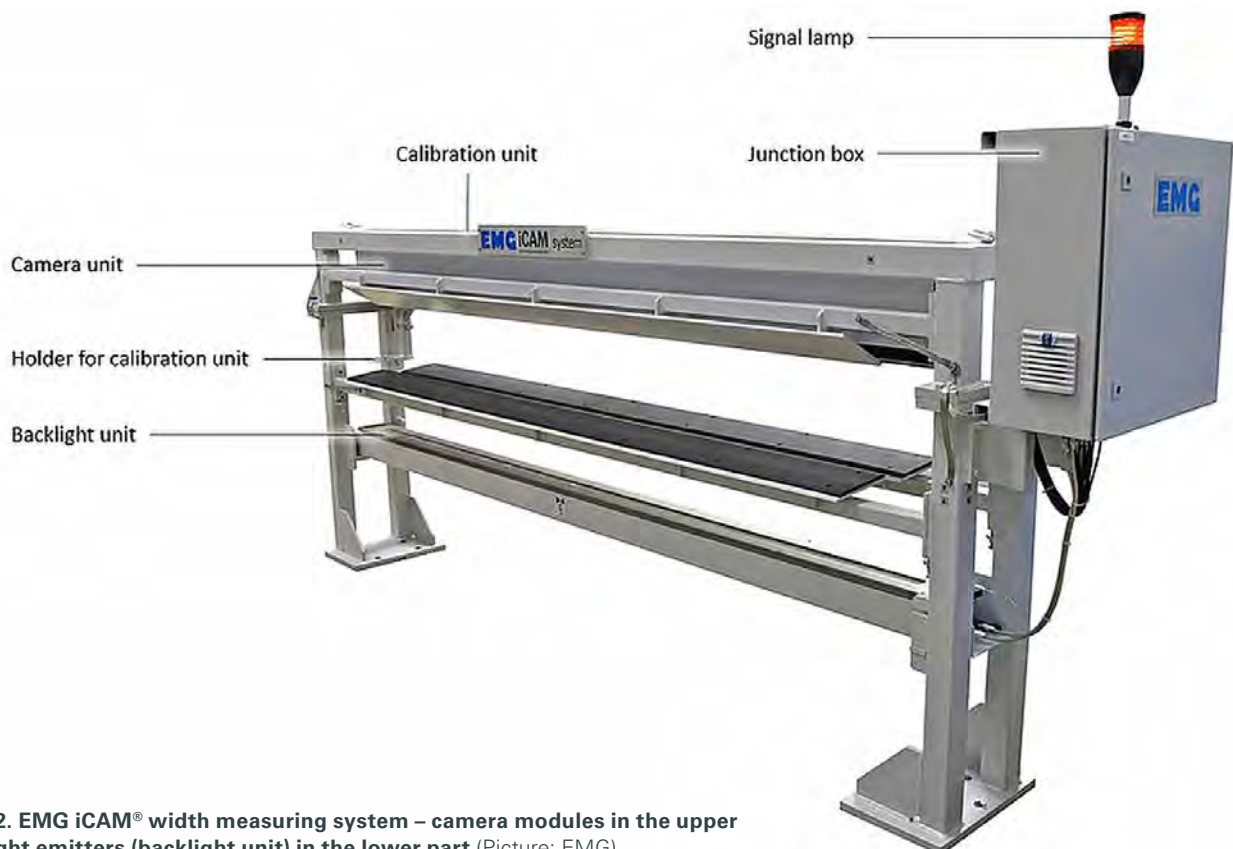
requirements for an intelligent width measurement system and offers additional the possibility to also measure slit strips after the slitting process with high precision.

**Strip thickness measurement with the EMG iTiM system family**

All materials have a certain tolerance in production; materials produced too thin or too thick can cause problems further down the production chain and finally at the end customer’s site. For SSCs and steel processors, the exact knowledge of the thickness of the incoming material is the key for the material allocation to different end customers and for the internal processing and machinery usage.

The expansion of EMG’s product portfolio to all the thickness measurement methods currently used in industry (X-ray, isotopes, laser), and the associated design and software know-how, opens completely new opportunities for the SSC user, also for modernisations and revamps.

Each technology has its own specific advantages and disadvantages, and in the



**Figure 2. EMG iCAM® width measuring system – camera modules in the upper part, light emitters (backlight unit) in the lower part** (Picture: EMG)

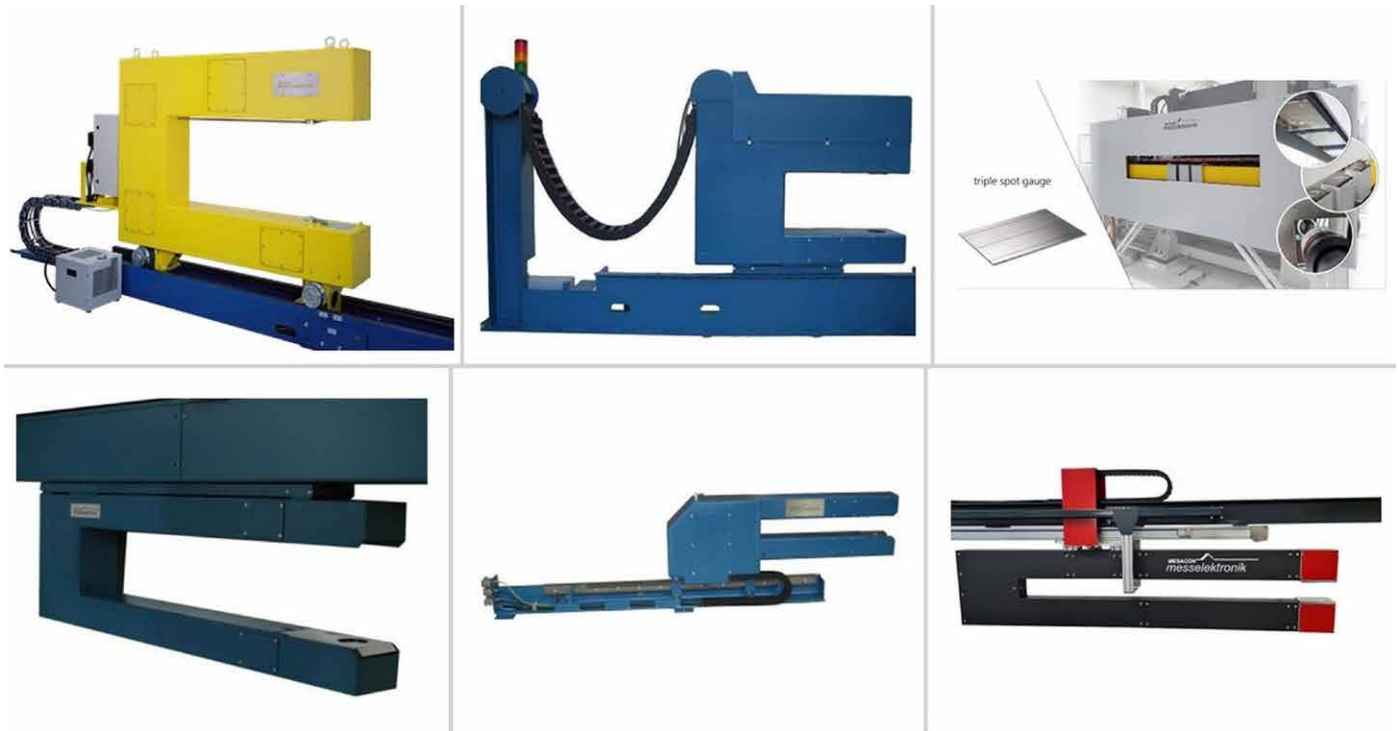


Figure 3. Three sensor technologies and plenty design concepts for EMG iTiM thickness measurement systems (Pictures: EMG)

end, it is the application that determines the selection or even the most appropriate combination of measurement methods.

**Strip thickness measurement EMG iTiM with isotope systems: an established solution**

EMG iTiM isotope radiation-based thickness measurement systems offer several advantages for the application in SSCs:

- › EMG iTiM iso systems can provide highly accurate thickness measurements; typically within 0.1% of the true thickness,
- › EMG iTiM iso systems can measure a wide range of thicknesses, typically from 200 µm to 150 mm (depending on the isotope used), which makes them suitable for measuring a variety of flat steel products,
- › EMG iTiM iso systems are designed to withstand harsh industrial environments, which makes them suitable for use in steel service centres,
- › EMG iTiM iso systems typically require minimal maintenance, which reduces operational costs and downtime.

The advantages and topics to consider with respect to thickness measurement

with EMG iTiM iso as well as selected technical data are summarised in **table 1**.

In summary, isotope-based techniques are well established in the SSCs and are used at many sites around the world. However, the major drawback is the increasingly limited availability of suitable isotope sources and the need to comply with relevant safety regulations, including those relating to radiation exposure and environmental protection. Fortunately, the

modular design of EMG thickness measurement solutions means that existing isotope sources can often be re-used for revamps and modernisations.

**Strip thickness EMG iTiM with laser solutions: flexibility is key**

EMG’s laser-optic systems are characterised by low complexity, reasonable space requirements and flexible integration into

Table 1. Overview EMG iTiM iso features and technical data

Advantages	To consider
No temperature influence	Limited availability of isotope sources
No surface dust, fog, vibration influence	Low spatial resolution
Industrial proven technology	Alloy compensation required
	Country specific installation, handling licences and import requirements for isotope sources
<b>Basic technical data EMG iTiM iso</b>	<b>E. g., for isotope Am 241</b>
Thickness range	0.05 mm - 7 mm
Measuring gap	Up to 400 mm
Accuracy (acc. to IEC 61336)	± 0.1% of measurement value, not better than 0.5 µm

the production line. Based on the principle of laser distance or difference measurement, triangulation sensors are mainly used for the EMG iTiM laser systems. In special cases, confocal monochromatic sensors can also be employed for even higher accuracy. Due to the complexity and sensitivity of the latter technology, triangulation sensors are the solution of choice in SSCs. Thanks to their compact design, the measuring systems can be easily integrated even in confined spaces and process lines. There are several arguments in favour of using EMG iTiM laser systems in SSCs:

- › EMG iTiM laser systems provide highly accurate measurements of flat steel in a very wide range between 200 µm to 150 mm, with precision up to the micrometre level.
- › EMG iTiM laser systems can be used to measure the thickness of all steel grades independent of the alloy composition. This makes them a versatile tool for steel service centres and processors.
- › EMG iTiM laser systems can still be a significant investment, but they are in general less costly and easy to integrate into new and running production lines, following a modular system.
- › EMG iTiM laser require no special certificates lowering the total cost of ownership dramatically.

The advantages and topics to consider as well as selected technical data for EMG iTiM laser are summarised in **table 2**. Overall, laser-based triangulation thickness measurement systems offer a range of benefits for SSCs and steel processors, including accuracy, speed, efficiency, versatility, and cost-effectiveness.

**Strip thickness EMG iTiM with X-ray: for special cases and with accuracy in focus**

The highest measuring accuracy and reliability is provided by the X-ray transmission measuring method. The X-ray source and detector are arranged on opposite sides of the material to be measured. The non-absorbed part of the X-ray radiation provides the basis for a highly precise thickness measurement, where material-related influences are compensated by the software. The EMG iTiM xray measuring system has been developed to ensure protection of the entire system even when

**Table 2. Overview EMG iTiM laser features and technical data**

Advantages	To consider
No cooling required	Sensitive to fog, dust, vibrations
No alloy compensation required	Certain sensitivity to surface structures
High spatial resolution	C-frame gap 120 - 300 mm
High range of gauges	Not suited for rolling applications
No special certificates or handling license for import required	
Basic technical data EMG iTiM laser	
Thickness range	0.1 - 150 mm
Measuring gap	100 - 300 mm
Accuracy (acc. to IEC 61336)	± 5 µm (for a measuring area of 20 mm)
Integration time	0.2 to 8 ms

used under the most difficult conditions in hot and cold rolling applications. For steel service centres this point is less important. As for the other system, **table 3** summarises the advantages, points to consider, and selected technical data for EMG iTiM xray solutions.

With respect to X-ray-based measurement techniques, it can be summarized that this method is well established in the steel sector. The X-ray measuring devices can be used over a wide thickness range













due to different generator voltages and deliver highly accurate measurement results. For metal service centres EMG iTiM xray only comes into play when high accuracy is required, or isotope-based systems are not available or should be avoided. Overall, while X-ray strip thickness measurement systems have advantages in terms of accuracy, they may be less practical and cost-effective for some steel service centres compared to laser or isotope-based systems.

**Table 3. Overview EMG iTiM xray features and technical data**

Advantages	To consider
No temperature influence	Handling of X-ray sources requires official approvals
No surface, dust, fog, vibration influence	Country specific installation and import requirements for X-ray sources
Low pass-line influence	Alloy compensation required
Medium spatial resolution	Higher thickness values require higher generator voltages
Very robust and stable systems	
High radiation safety (can be shuttered or switched-off)	
Basic technical data EMG iTiM xray	
Thickness range	0.002 - 60 mm
Measuring gap	Up to 2,000 mm
Accuracy (acc. to IEC 61336)	± 0.1% of measurement value
Integration time	≥ 1 ms (selectable)



**Table 4. Selection criteria for EMG SOLID IR® or alternatively EMG SOLID LIF® systems**

		Usable solution	
		EMG SOLID® IR	EMG SOLID® LIF
Installation situation	Homogenisation rolls exist or can be installed		
	Not enough space for homogenisation rolls		
Needed measuring range	< 0,1 – 6 g/m <sup>2</sup>		
	> 0,1 – 6 g/m <sup>2</sup>		
Used lubricants	Oils with similar fluorescence characteristics		
	Oils with different fluorescence characteristics and no oil mixtures		
	Oils with different fluorescence characteristics and oil mixtures		
Material surface	shiny / strongly reflecting (e.g. bright-annealed stainless steel)		

**Revamping thickness measurement solutions with EMG iTiM**

Economic efficiency is the main factor in deciding whether to reuse existing equipment. Retrofitting existing installations with EMG iTiM can save over 70% compared to new purchases due to the modularity and design flexibility of the system. Especially when existing radioactive sources can be reused.

**Plug and play**

Due to the modularisation of the EMG iTiM solutions and a special design of the mechanics, these systems are ideally suited for such revamps. The replacement of these old systems can be accomplished within a few hours in one or two shifts. The plug and play capability of the EMG iTiM systems also makes it possible to ship them in a fully assembled state. This often

eliminates time-consuming assembly processes when installing the system in the plant.

**Lubrication of coils and sheets – oil layer thickness measurement with EMG SOLID® IR & LIF**

There are several important aspects concerning online oil layer measurement in SSCs and flat metal processing:

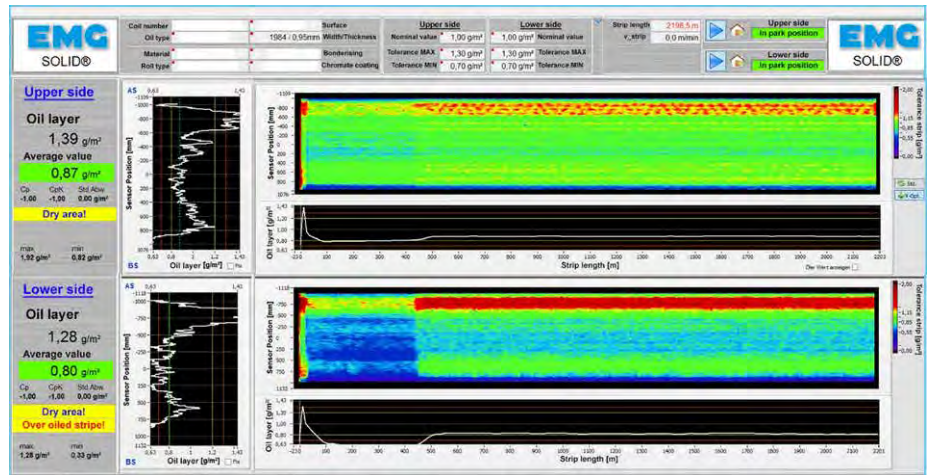
**Table 5. Key features and technical data for EMG SOLID® IR and EMG SOLID® LIF**

Key features and data	EMG SOLID® IR	EMG SOLID® LIF
Measuring range	0.1-6 g/m <sup>2</sup>	0.1-6 g/m <sup>2</sup>
Measuring accuracy	± 0.1 g/m <sup>2</sup> [0.1-0.5 g/m <sup>2</sup> ] ± 0.2 g/m <sup>2</sup> [0.5-2.0 g/m <sup>2</sup> ] ± 10% of upper measuring range value [ $> 2.0 \text{ g/m}^2$ ]	± 10% of upper measuring range value
Materials	All metal and non-metal surfaces with low glossy level	All metal and non-metal surfaces
Lubricant types	Mineral oil, mineral oil thixotropic, hotmelts, waxes	Mineral oil, mineral oil thixotropic, waxes, hotmelts, rolling and skin pass agents, cooling lubricants, emulsions
Other coating materials	Insulation coatings for electrical steel	Insulation coatings for electrical steel, passivations, anti-corrosive agents, anti-fingerprint coatings, cleaning agents, transparent lacquers, polymers, primers, adhesives
Measuring distance	120 mm (transversing)	40 mm (transversing)
Special requirements	Homogenisation rolls in front of the measurement frame	Not suited for oils with different fluorescence characteristics and oil mixtures

- › Online oil layer measurement helps ensure consistent oiling of steel coils, which is critical for achieving consistent quality in downstream processing and end products. That is not only true for determining a sufficient lubrication for the planned processing, but also for providing an oil-free surface before coatings or paintings are applied.
- › Accurately measuring the oil layer can help optimize the amount of oil used, reducing waste and costs associated with over-oiling or under-oiling coils.
- › By measuring the oil layer online, service centres can quickly and easily adjust oiling systems to maintain optimal levels, without the need for time-consuming manual measurements.
- › Over-oiling and oil leaking from coil windings can create a slippery surface that can be hazardous for workers and for coil logistics.

EMG offers two technological approaches for oil layer measurement: infrared spectroscopy with EMG SOLID® IR and laser-induced fluorescence spectroscopy with EMG SOLID® LIF. Each technology has its advantages and limitations, so the best option is used for each application. In about two-thirds of cases, the widely established EMG SOLID® IR technology is applied (due to the robustness against effects of oil mixtures).

In **table 4** the main criteria for the selection of the underlying measuring principle are summarised. **Figure 4** shows the online visualisation of EMG SOLID®. Overoiled zones are shown in red colour whereas dry areas or underoiled areas are highlighted in blue for both sides of the



**Figure 4. Coil map with lubrication profile and overoiled and dry zones** (Picture: EMG)

coil. In **table 5** key features and technical data are compared for the two underlying measurement technologies.

In summary: EMG SOLID® covers a wide range of applications in online oil layer measurement in the metal industry. Depending on the application requirements, either infrared technology or laser-induced fluorescence technology is used. On request, EMG can supply a complete solution including additional units, such as C-frames or homogenising rolls, including the design integration into the production plant and the associated commissioning services.

**EMG scope of delivery: from components, systems and service to turn-key solutions**

EMG offers technical solutions, components, systems, and service with consul-

tancy. The EMG service team has global presence, providing spare parts, consultancy, and expertise in strip guiding and quality assurance solutions for SSCs and steel processors. EMG offers customised solutions through partnerships with local representatives and subsidiaries. EMG’s experience in revamps and modernisations helps companies improve efficiency, reduce downtime, and increase product quality, meeting changing market demands and regulations. EMG also offer turn-key projects, taking full responsibility for the project from concept to completion.

Or to make a long story short: EMG speaks the same language as the customer, both technically and verbally.

*METEC, Hall 1 – Stand D44*

**EMG Automation GmbH**

## RAISING DEMAND FROM THE PHOTOVOLTAIC SECTOR

# Wuppermann Austria commissions new roll forming line

The Austrian company has expanded the range of profiles with highest corrosion protection. The production capacities has been enlarged particularly to meet the demand from the photovoltaic industry.



**Steel profiles for the photovoltaic industry produced by Wuppermann Austria**  
(Picture: Wuppermann)



**Judenburg works is one of five production sites within the Wuppermann Group**  
(Picture: Wuppermann)

Steel processor Wuppermann Austria GmbH commissioned a new roll forming line at its Austrian site in Judenburg in March 2023. The total investment for the construction of the new plant amounts to 13 million euros. The specialist for galvanized products for the highest corrosion protection requirements is thus significantly expanding its manufacturing capabilities and production capacities.

The new roll forming line with automatic packaging line offers a wider range of dimensions and thus also a wider range of products: The company can now produce larger cross sections and thus offer its customers a wide production range of welded profiles with complex geometries as well as open profiles with a significantly wider range of profile widths and heights.

The new line can process pre-material with a width of between 100 to 600 mm. Profiles can be produced with a strip thickness of 1.5 to 4.0 mm, a profile width of 25 to 300 mm, a profile height of 20 to 140 mm and a length of up to 13.5 metres. With a zinc coating of up to 1,300 g/m<sup>2</sup> (Z1300) or a zinc-magnesium coating of up to 1,000 g/m<sup>2</sup> (ZM1000) and optional galvanized edge, these products also meet the highest requirements for corrosion protection.

In addition, steels with higher tensile strengths of up to 1,000 MPa can be processed. Furthermore, the plant has opted for a process-integrated punching of strips that allows the strip to be punched in one production step before profiling. This means that profiles can now be produced with individual and complex hole patterns according to customer requirements in a time- and cost-saving manner and delivered with piece-by-piece precision.

The plant in Styria thus meets the requirements of the photovoltaic industry

### Dimensions and performance parameters of the new roll forming line

› Strip width:	100-600 mm	› Tensile strength:	max. 1,000 MPa
› Strip thickness:	1.5-4.0 mm	› Length:	max. 13.5 m
› Profile width:	25-300 mm	› Punching of strips:	inline
› Profile height:	20-140 mm		(Source: Wuppermann)

in particular: complex profiles with demanding geometries, high repeatability in production, durability and maximum corrosion protection. Thanks to the combination of higher-strength steels and high material thickness, the profiles also meet special requirements in terms of span width and load-bearing capacity, such as for so-called agri-PV systems.

However, the complex profiles can also be used in various sectors and markets outside the photovoltaic industry.

“WA is the ideal location within the Wuppermann Group for the new roll forming line. Our employees can now also contribute their many years of experience and technological know-how in the production of galvanized tubes and profiles as well as in strip perforation to the new roll forming line,” explains Hubert Pletz, Managing Director of WA.

“With the new roll forming line, we can now offer our customers a greater variety of products with the highest level of cor-

rosion protection and are thus responding to demand, particularly from the photovoltaic industry. With our profiles, we are actively supporting the expansion of sustainable energy generation in Europe,” adds Johannes Nonn, Spokesman of the Executive Board of Wuppermann AG.

Wuppermann

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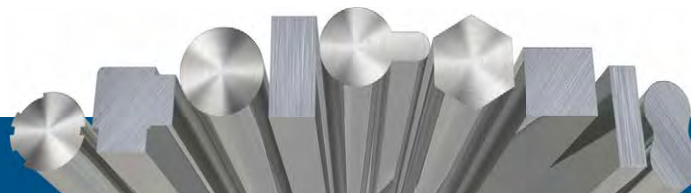
## PRODUCT ADVANTAGES AT A GLANCE

- Reduced energy input during the following heat treatment process
- Significant improvement in distortion.
- Significant improvement in coercivity and remanence.
- Significant improvement of tensile strength to yield strength ratio. Tensile strength is almost maintained. Yield strength is significantly reduced.



## ANDERNACH & BLECK

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**CUT WEIGHT AND HAUL MORE FREIGHT**

# Performance steel for construction and transportation equipment

SSAB featured Strenx® performance steel and the benefits it brings to construction equipment at CONEXPO-CON/AGG 2023 – the largest trade fair for the construction industry in North America. Strenx® is a high-strength structural steel that successfully helps manufacturers build stronger, lighter and more sustainable equipment, in uses ranging from lifting and land clearing to earthmoving, material handling, hauling and trucking.

Today's heavy equipment needs to haul more, load more and lift more loads safely, requesting equipment owners to deal with the challenge of operating heavier equipment, rising fuel costs and driver shortages. On the roads, as container weights increase, equipment tare weights need to decrease to keep within the legal limits for gross vehicle weight. Strenx® steel is helping to meet the market's need for lighter, yet durable trailer chassis and booms to maximize load-carrying capacity.

For example, Strenx® in an upgraded side-dump trailer design was a game-changer that brought major weight savings to trailer and body builder Cross Country Manufacturing, Canadian trailer manufacturer. "Customers benefit with an improved cost of ownership through operational savings such as lower fuel consumption," says Bill Yorke, Cross Country Manufacturing VP Sales. "They can enjoy a higher return on investment because the lighter overall

weight puts the vehicle in a lighter licensing class, providing tare weight savings. We were able to add capacity without adding more weight, increasing payload, which means fewer trips, higher productivity and fuel efficiency."

Strenx® is also used in rear impact guards for underride protection to help lower the risk of fatal injuries in rear-end collisions, providing a better strength-to-weight ratio than aluminium guards.

### Put higher productivity within reach

As a steel with high yield strength, Strenx® has proven successful in lifting equipment, bringing more power, reach and flexibility to the job site. It is designed to work under high load stresses without compromising on safety or causing equipment failure, providing maximum strength, lift height and lift capacity at less weight. Strenx® high-strength steel plate, tubes and hollow

sections in reduced thicknesses can benefit cranes, hoists, spider lifts, scissor lifts, boom lifts, cherry pickers, telehandlers and more. Thanks to its tight thickness and flatness tolerances, Strenx® steel enables fabricators to accurately bend the components needed.

How Strenx® benefits construction and transportation equipment:

- › improved trailer design for safety,
- › greater boom reach in lifting equipment,
- › fuel efficiency gains and higher profitability overall,
- › lighter-weight models give operators lower cost of ownership,
- › increased profitability due to higher payloads and lower fuel consumption,
- › easy to weld, cut and form using regular workshop techniques.

Strenx® steel makes a more sustainable choice. Strenx® is made in a steelmaking process that is already the world's most CO<sub>2</sub> efficient. By specifying Strenx® in thinner steel gauges, manufacturers can use less steel. Switching to Strenx® steel also makes equipment lighter and more efficient in terms of both fuel consumption and CO<sub>2</sub> emissions. By 2026, "fossil-free" Strenx® will be available from a process that virtually eliminates CO<sub>2</sub> emissions.

"Our theme is Think Thinner, Get Stronger," said Magnus Carlsson, product manager for Strenx® performance steel. "Our range of steels can help manufacturers, fleet owners and operators become more productive in challenging environments, and in changing industries that are becoming more focused on sustainability."



**Cross Country Manufacturing in Manitoba, Canada, side tipper model increased profitability with Strenx® steel due to higher payloads and lower fuel consumption**

(Picture: SSAB)

SSAB

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<b>13</b>	<b>Production of tubes/pipes</b>	<b>28</b>	<b>Steel in civil engineering</b>
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**03 Iron making**

**03.01 Blast furnaces**

1150 Heat recovery systems



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**03.02 Direct reduction plants**

1160 Direct reduction plants



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**04 Steelmaking**

1668 Equipment for steelmaking plants



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1670 Engineering and technical assistance



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1698 Steel mill plants and equipment



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1699 Steel mill equipment



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**04.04 Electric steel plant**

1875 Electric arc ladle furnaces



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**04.07 Secondary metallurgy**

2028 Equipment for chemical heating



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2030 Argon purging equipment

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2080 Ladle metallurgical plants



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## 2110 Secondary metallurgical plants



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## 2120 Steel degassing plants



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## 2130 Steel desulfurization plants



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## 2140 T+P lance equipment



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## 04.08 Tertiary metallurgy

## 2144 Vacuum degassing equipment



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## 04.09 Components

## 2150 Deslagging machines



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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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## 2230 Charging machines (trough and tongs)



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## 2270 Injection plants for argon

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Internet: [www.BEDA.com](http://www.BEDA.com)

## 2440 Handling equipment for oxygen/carbon lances

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## 2490 Coal dust injection lances

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## 2530 Lance robots/-manipulators

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2580 Oxygen nozzles



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

2600 Oxygen lance equipment

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

2655 Fuses (multifunction) for burners

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

2660 Special safety oxygen hose reels

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

04.10 Steel works materials

2735 EBT taphole plugging compound



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

2880 Ladle slide sand



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

07 Hot rolling

07.10 Components

4430 Decoilers and rewinders



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

08 Forging, extrusion

08.03 Components

5150 Forging manipulators



**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

5155 Forging manipulators, rail-mounted



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



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

5160 Forging robots



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



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

5180 Transport manipulators



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

10 Cold rolling

10.01 Cold rolling mills

5490 Strip, sheet, cold and metal rolling mills



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

**10.04 Annealing lines**

5670 Annealing lines



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

**11 Surface treatment**

**11.04 Surface treatment plants**

6270 Strip edge trimming



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

6280 Strip processing and finishing lines



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

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

7544 Tube straightening machines



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

**14 Sheet metal processing**

**14.03 Welding technology**

8120 Strip welding machines



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

8205 Laser welding machines



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

8210 Laser beam welding machines



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

8220 MIG, MAG and TIG\057TIG welding torches



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

8257 Rolling seam resistance welding equipment



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

8330 Welding machines, general



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

8360 Welding accessories, general



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

8380 Butt welding machines, electric



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

8400 Resistance welding equipment



**GUILD International**  
7273 Division Street  
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☎ +1 440-232-5887  
E-Mail: sales@guildint.com

**16 Furnace and energy technology**

10170 Furnace optimization (conversion to low NOx combustion)



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**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

10190 Rational use of energy



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71272 Renningen, Germany  
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☎ +49 7159 2738  
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16.02 Forging furnaces

10230 Forging furnaces



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Internet: www.loi.tenova.com

16.03 Roller Hearth Continuous Furnaces

10260 Roller Hearth Continuous Furnaces



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☎ +49 203 80398-900  
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E-Mail: loi@tenova.com  
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10270 Roller hearth and walking beam furnaces



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☎ +49 203 80398-900  
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16.05 Top-hat furnaces

10310 Top-hat furnaces



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16.08 Heating furnaces and heat treatment plants

10408 Continuous furnaces



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10410 Co-step furnaces



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10430 Bogie hearth furnaces



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10460 Chamber furnaces



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

10510 Roller hearth and walking beam furnaces



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10540 Pusher-type, roller and rotary hearth furnaces



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

10560 Heat treatment plants



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 E-Mail: loi@tenova.com  
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10562 Heat treatment furnaces (continuous and discontinuous)



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

10570 Heat treatment furnaces for batch operation, open heated



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

16.09 Bath furnaces

10580 Aluminum melting furnaces



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

16.13 Components

10890 Natural gas burners



**WS 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  
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 ☎ +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

11070 Radiant tube burners



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 ☎ +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



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 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**

13070 Piston pumps



**HYDROWATT AG**  
 Freistrasse 2  
 8200 Schaffhausen, Switzerland  
 ☎ +41 52 624 53 22  
 ☎ +41 52 625 62 11  
 E-Mail: info@hydrowatt.com  
 Internet: www.hydrowatt.com

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

**21 Measuring and testing technique**

**21.01 Measuring and testing technology, general**

16510 Measurement technology



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

16520 Measuring and testing systems, general



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

**21.02 Measurement of physical properties**

16830 Speed measuring devices



**POLYTEC GmbH**  
 Polytec-Platz 1-7  
 76337 Waldbronn, Germany  
 ☎ +49 7243 604-0  
 ☎ +49 7243 69944  
 E-Mail: info@polytec.de  
 Internet: www.polytec.de

16910 Length measuring devices for tubes



**POLYTEC GmbH**  
 Polytec-Platz 1-7  
 76337 Waldbronn, Germany  
 ☎ +49 7243 604-0  
 ☎ +49 7243 69944  
 E-Mail: info@polytec.de  
 Internet: www.polytec.de

16960 Laser speed and length measuring systems



**POLYTEC GmbH**  
 Polytec-Platz 1-7  
 76337 Waldbronn, Germany  
 ☎ +49 7243 604-0  
 ☎ +49 7243 69944  
 E-Mail: info@polytec.de  
 Internet: www.polytec.de

**24 Environmental protection and disposal**

**24.01 Dedusting and gas cleaning**

18360 Exhaust gas cooling systems



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

18400 Treatment of dusts from steel mills and foundries



**Maschinenfabrik Gustav Eirich GmbH & Co KG**  
 Walldürner Str. 50  
 74736 Hardheim, Germany  
 ☎ +49 6283 51-0  
 ☎ +49 6283 51-325  
 E-Mail: eirich@eirich.de  
 Internet: www.eirich.de

# List of Products

## 01 Raw materials, auxiliary materials and operating materials

### 01.01. Ores

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

### 01.02. Coal, coke

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

### 01.03. Scrap

- 120 Scrap metal

### 01.04. Sponge iron

- 128 Sponge iron
- 130 Sponge iron

### 01.05. Metals and alloys

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

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

### 01.06. Additives and fluxes

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

### 01.07. Gases

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

### 01.08. Lubricants

- 680 Coating powder
- 690 Lubricants

### 01.09. Composite materials

- 678 Bimetal for saws

### 01.10. Water

- 691 River water / additional water

### 01.11. Other

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

## 02 Raw material pretreatment

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

### 02.01. Ore dressing

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

- 750 Screens
- 760 Screens and screening plants

### 02.02. Coal preparation

- 770 Coal preparation plants
- 780 Coal grinding plants

### 02.03. Coal burden preparation

- 790 Coal burden preparation

### 02.04. Pelletizing plants

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

### 02.05. Sintering plants

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

### 02.06. Briquetting plants

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

### 02.07. Coke plants

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

### 02.08. Scrap processing plants

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

### 02.09. Other equipment

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



**03 Iron making**

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

**03.01. Blast furnaces**

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

**03.02. Direct reduction plants**

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

**03.03. Cupola furnaces**

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

**03.04. Components**

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

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

**03.05. Blast furnace products for foundries**

- 1490 Foundry pig iron
- 1500 Hematite pig iron
- 1510 Hematite pig iron for 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) bloom and billet adjustments
- 3490 Heat exchangers
- 3500 Weighing systems for ladles, tundish etc.
- 3510 Two-substance nozzles for continuous casting cooling

**05.05. Operating materials**

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

**05.06. Services**

- 3537 Grinding and scarfing of slabs, billets and blooms

**06 Near net shape casting**

- 3540 Engineering and technical assistance

**06.01. Equipment**

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

**06.02. Components**

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

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

**06.03. Operating supplies**

- 3750 Coolant
- 3760 Lubricants

**07 Hot rolling**

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

**07.01. Hot strip mills**

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

**07.02. Heavy plate mills**

- 3850 Hot rolling mills, complete

**07.03. Billet and semi-finished product mills**

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

**07.04. Section mills**

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

**07.05. Bar and wire rod mills**

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

**07.06. Ring rolling mills**

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

**07.07. Finishing lines**

- 3990 Finishing lines
- 4000 Finishing machines

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

**07.08. Rolls for hot rolling mills**

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

**07.09. Roll machining and machines**

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

**07.10. Components**

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

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

**07.11. Operating fluids**

- 4900 Lubricants for hot rolling mills

**07.12. Services**

- 4920 High wear resistant coating on rolls etc.

**08 Forging, extrusion**

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

**08.01. Forging machines**

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

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

**08.02. Extrusion presses**

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

**08.03. Components**

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

**08.04. Operating materials**

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

**09 Powder metallurgy**

- 5200 Engineering and technical assistance
- 5210 Powder Metallurgy

**09.01. Hard alloys**

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

**09.02. Hard materials**

- 5290 Tungsten carbide

**09.03. Hard metal powders**

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

**09.04. Additives**

- 5320 Binder metals
- 5330 Organic additives

**09.05. Machines and equipment for powder production**

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

**09.06. Machines and equipment for production of powder metallurgical products**

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

**09.07. Powder metallurgy manufactured products**

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

**09.08. Further processing of powder metallurgy products**

- 5460 Plasma powder cladding
- 5470 Thermal spraying

**09.09. Additive manufacturing**

- 5475 3-D printing
- 5476 Additive manufacturing processes

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

**10.05. Rolls for cold rolling mills**

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

**10.06. Components**

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

**10.07. Operating materials**

- 5960 Lubricants for cold rolling

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

**11.02. Pickling plants**

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

**11.03. Grinding and polishing machines**

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

**11.04. Surface treatment plants**

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

**10 Cold rolling**

- 5480 Engineering and technical assistance

**10.01. Cold rolling mills**

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

**10.02. Skin pass mills**

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

**10.03. Finishing lines**

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

**10.04. Annealing lines**

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

**11 Surface treatment**

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

**11.01. Descaling equipment**

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

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

**11.05. Aluminizing, tin plating, galvanizing**

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

**11.06. Corrosion protection**

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

**11.07. Components**

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

**11.08. Operating materials**

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

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

**11.09. Services**

- 6906 Large format surface grinding
- 6910 Contract finishing

**11.10. Wear protection**

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

**12 Production of bright steel and wire**

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

**12.01. Wire rod mills**

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

**12.02. Wire, bar and profile drawing**

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

**12.03. Finishing lines for drawing shops**

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

**12.04. Components**

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

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

**12.05. Operating supplies**

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

**13 Production of tubes / pipes**

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

**13.01. Tube rolling mills**

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

**13.02. Tube drawing machines**

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

**13.03. Pipe welding machines**

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

**13.04. Finishing lines for tubes**

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

**13.05. Components**

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

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

**14 Sheet metal processing**

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

**14.01. Plants, presses, machines**

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

**14.02. Slitting lines**

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

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

**14.03. Welding technology**

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

**14.04. Components**

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

**14.05. Services**

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

**15 Steel products**

**15.01. Rolled steel**

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

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

**15.02. Pipes**

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

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

**15.03. Forgings**

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

**15.04. Railroad rolling stock**

- 9540 Axles
- 9550 Wheel tires

**15.05. Steel in the following delivery forms**

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

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

**15.06. Drawing and cold rolling mill products**

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

**15.07. Wire and wire products**

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

**15.08. Steel construction**

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



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

**15.09. Services**

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

**16 Furnace and energy technology**

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

**16.01. Rolling mill furnaces**

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

**16.02. Forging furnaces**

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

**16.03. Roller Hearth Continuous Furnaces**

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

**16.04. Continuous furnaces for wide strip**

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

**16.05. Top-hat furnaces**

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

**16.06. Vacuum furnaces**

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

**16.07. Hardening and tempering equipment**

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

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

**16.08. Heating furnaces and heat treatment plants**

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

**16.09. Bath furnaces**

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

**16.10. Industrial furnaces for special purposes**

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

**16.11. Protective gas plants**

- 10670 Protective gas plants

**16.12. Insulations**

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

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

**16.13. Components**

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

**16.14. Operating materials**

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

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

**16.15. Services**

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

**17 Refractory technology**

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

**17.01. Raw materials, precursors and binders for refractory materials**

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

**17.02. Plants for the production of refractory materials**

- 11400 Equipment for the production of refractory materials

**17.03. Refractory materials and equipment**

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

- 11512 Refractory concrete, high strength, for industrial floors
- 11520 Refractory products, general
- 11530 Refractory ramming mixes
- 11540 Refractory anchorages
- 11550 Refractory material
- 11560 Lightweight refractory bricks
- 11570 Lightweight refractory and insulating mixes
- 11580 Lightweight refractory and insulating bricks
- 11590 Gas purging equipment, refractory
- 11600 Pouring mixes, self-flowing
- 11610 hearth masses
- 11620 High-fire bricks
- 11630 Blast furnace bricks
- 11640 Induction furnace mixes
- 11650 Insulating material, asbestos-free
- 11660 Isostatically pressed products
- 11670 Carbon and graphite bricks
- 11690 Converter bricks
- 11700 Arc furnace bricks
- 11710 Perforated bricks
- 11720 Masses, refractory (general)
- 11725 MgO-C bricks
- 11730 Mortars and mastics, refractory
- 11740 Mux masses
- 11750 Ladle masses
- 11752 Torpedo ladle lining
- 11755 Ladle lining, monolithic
- 11760 Ladle bricks
- 11768 Products made of \ 050HTW \ 051 high temperature wool
- 11790 Gutter and taphole masses
- 11800 Gutter lining, cooled
- 11810 Acid resistant bricks
- 11820 Acid ramming and centrifugal masses
- 11830 Firebricks
- 11840 Shadow pipe
- 11850 Slide gate ceramics
- 11860 Cast basalt
- 11865 Protective blankets made of textile fabric, refractory
- 11870 Silicon carbide bricks
- 11880 Silica bricks, tondina bricks
- 11886 Special adhesives up to 1200 °C
- 11890 gunning and repair compounds
- 11900 Steel mill wear material
- 11910 ramming, casting and vibrating masses
- 11915 ramming, spraying and casting compounds
- 11920 Stoppers and spouts
- 11930 Continuous castings, refractory
- 11940 Immersion tube, monota immersion spout
- 11950 Technical ceramics
- 11960 High-alumina bricks (andalusite, bauxite, corundum, mullite, sillimanite bricks)
- 11970 Torpedo mixer stones
- 11980 Tundish masses
- 11985 Pouring compounds, cement-free, for blast furnace tapping troughs
- 11990 Vermiculite
- 12000 Thermal insulation materials, asbestos-free
- 12004 Vacuum formed parts
- 12005 Vacuum formed parts, without ceramic fibers
- 12010 Wollastonite

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

**17.04. Processing of refractory materials**

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

**17.05. Machines for refractory construction**

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

**17.06. Refractory construction**

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

**17.07. Services**

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

**18 Machinery and plant engineering**

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

**18.02. Chemical plants and accessories**

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

**18.03. Steam generation plants and equipment**

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

**18.04. Foundry equipment, machinery and supplies**

- 12354 Casting ladles
- 12500 Molding machines
- 12530 Foundry equipment, machines and supplies
- 12535 Foundry tools
- 12540 Foundry consulting and engineering
- 12542 Foundry software
- 12550 Core shooters
- 12560 fettling machines
- 12570 Robots
- 12580 Sand mixers
- 12586 Melting furnaces, inductive
- 12590 Shaking ladles
- 12592 Crucible tongs
- 12605 Vacuum investment casting plants-super alloys
- 12607 Vacuum investment casting plants with cold crucibles for titanium or titanium alloys

**18.05. Power plants and power stations**

- 12610 Power plants and power stations, steam
- 12620 Power plants and power stations, electric

**18.06. Ventilation plants and equipment**

- 12630 Blowers
- 12635 Industrial fans
- 12650 Air conditioners, general
- 12660 Air conditioners for heat plants
- 12670 Air conditioners for crane lances, crane bridges, etc.
- 12690 Expansion joints
- 12700 Ventilation ducts
- 12710 Ventilation systems and equipment, general
- 12720 Natural ventilation
- 12730 Induced draught systems and equipment
- 12740 Ventilators

**18.07. Water treatment plants, equipment and accessories**

- 12750 Chemical water treatment
- 12760 Pressurized water plants and accumulators
- 12770 Filtering plants for circulating water
- 12780 Rubber compensators

- 12790 Cooling towers
- 12793 Cooling water / circulating water systems
- 12796 Magnetic filters
- 12800 Press water additives
- 12810 Water treatment systems
- 12830 Water demineralization, treatment and recycling
- 12840 Water recooling systems
- 12846 Water filtration

**18.08. Other plants**

- 12848 Chillers
- 12850 Slag granulation hoses
- 12860 Slag recycling plants (also slag granulation plants)
- 12862 Slag granulation plants
- 12870 Lube oil plants

**18.09. Maintenance**

- 12880 Spare parts and consumables
- 12890 Maintenance, general
- 12892 Maintenance organization
- 12894 Maintenance systems
- 12896 Repair, overhaul and modernization of machine tools
- 12900 Maintenance of large gear units
- 12920 Maintenance of continuous casting plants for ingots and slabs
- 12930 Maintenance of continuous casters for ingots and billets
- 12950 Repair of ingot molds
- 12960 Repair of ingot molds
- 12964 Cooling system cleaning
- 12970 Ladle repair, FF
- 12980 Repairs, spare parts
- 12983 Software for maintenance
- 12990 Preventive maintenance
- 13000 Heat exchanger cleaning
- 13010 Condition based machine maintenance

**18.10. Power and work machines**

- 13020 Steam turbines
- 13021 Gas turbines
- 13030 Rotary compressors
- 13040 Compressed air equipment
- 13050 Natural gas, gas transmission compressor stations
- 13060 Natural gas HP storage
- 13070 Piston pumps
- 13080 Piston compressors
- 13083 Corrosion resistant pumps
- 13090 Centrifugal pumps
- 13100 Mixing units for all fuel gases
- 13120 Lubrication pumps
- 13130 Screw compressors
- 13150 Turbo compressors
- 13160 Vacuum pumps

**18.11. Gearboxes and drive elements**

- 13168 Drive elements
- 13170 Drive engineering
- 13174 Valve gearboxes
- 13180 Brakes
- 13190 Brake disc mounting
- 13195 Torque limiter
- 13200 Flange couplings

- 13210 Cardan joints
- 13220 Cardan shafts
- 13230 Gear rollers
- 13240 Gearboxes and drive elements
- 13250 Large gearboxes
- 13255 Chain drives and sprockets
- 13260 Hirth serration
- 13261 Hirth spur gearing
- 13270 Couplings
- 13285 Couplings, flexible, elastic
- 13290 Couplings, mechanical and hydrodynamic
- 13300 Planetary gearboxes
- 13308 Slew drives
- 13310 Safety couplings
- 13318 Spindles
- 13320 Special constructions
- 13350 Shaft-hub couplings (backlash-free)
- 13360 Shaft couplings (rigid)
- 13370 Winding shafts
- 13380 Gear drives
- 13390 Gear wheels
- 13395 Gearbox repairs

**18.12. Bearings**

- 13400 Slewing rings
- 13404 Elastomeric bearings
- 13406 Spherical plain bearings / rod ends
- 13410 Plain bearings
- 13420 Ceramic-metal compact plain bearings
- 13430 Ball bearings
- 13440 Cam rollers
- 13460 Linear systems
- 13470 Roller bearings
- 13480 Yoke type track rollers
- 13484 Thermal separation
- 13485 Support and guide rollers
- 13490 Rolling bearings
- 13492 High-temperature rolling bearings
- 13500 Roller bearings

**18.13. Oil hydraulic systems, equipment and accessories**

- 13508 Rotary distributors
- 13510 Rotary feeders
- 13520 Pressure measuring, switching and writing devices
- 13530 Pressure switch
- 13540 High pressure flange connectors
- 13550 Hydraulic systems
- 13560 Hydraulic and shaft seals
- 13570 Hydro gears
- 13580 Hydro motors
- 13590 Hydro pumps
- 13595 Hydraulic accumulators
- 13600 Hydro valves
- 13610 Hydraulic cylinders
- 13620 Oil hydraulic systems, devices and accessories
- 13630 Vibration dampers
- 13640 Servo valves
- 13645 Continuous valves
- 13660 Complete plants, oil hydraulic
- 13670 Water hydraulic

**18.14. Control systems and components**

- 13680 Shut-off valves

- 13690 Automatic inflow control with distribution gate valves
- 13695 Torque limiters
- 13710 Electro-hydraulic actuators
- 13718 Electro-servo cylinders
- 13720 Multipoint single and multi-purpose regulators
- 13730 Control systems, complete
- 13740 Control valves
- 13760 Actuators
- 13780 Continuous single and multi-purpose regulators

**18.15. Piping and accessories**

- 13786 Exhaust gas technology
- 13790 Butterfly valves
- 13800 Asbestos-free fabric expansion joints
- 13810 Fittings
- 13820 Flanges
- 13840 Rubber expansion joints
- 13850 High pressure pipe technology
- 13859 Safety valves
- 13860 Expansion joints
- 13890 Pipe break safety valves
- 13900 Pipe swivels
- 13910 Piping and accessories
- 13920 Pipeline construction
- 13930 Piping accessories
- 13940 Check valves
- 13945 Hoses
- 13947 Flexible hoses with ceramic wear protection
- 13950 Plug-in disc gate valves

**18.16. Stranding machines**

- 13955 Stranding machines
- 13958 Rope making machines

**18.17. Tool and model making**

- 13956 Mold frames, mold assemblies
- 13960 Materials for model and prototype construction
- 13970 Model and prototype making

**18.18. Machine tools**

- 13980 Cutting-off machines
- 13990 External thread cutting machines
- 14000 Band sawing machines
- 14010 Bending and straightening machines
- 14015 Slab sawing machines
- 14020 Wire working and processing machines
- 14030 Flow-forming machines
- 14040 Milling machines
- 14060 Spark erosion machines
- 14070 honing and lapping machines
- 14080 Cable sheathing presses
- 14081 Cable sheathing presses (lead and aluminum)
- 14088 Sharpening machines
- 14090 Cold circular saws
- 14095 Hot circular saws
- 14100 Mould processing machines
- 14120 profile and flat shears
- 14130 Shears (standing, flying) for metallurgical operations
- 14140 Shears (standing, flying) for sheet metal working

- 14150 Shearing centers
- 14160 Grinding and polishing machines (also internal)
- 14170 Special machines for chip forming
- 14180 Special machines for chipless forming
- 14190 Special machines for special tasks
- 14195 Concrete sawing machines
- 14200 Stone cutting saws
- 14210 Plate shears
- 14220 Cut-off machines

**18.19. Tools**

- 14230 Press brake tools
- 14240 Drills
- 14242 Taphole drilling tools
- 14250 Diamond tools
- 14260 Pneumatic tools
- 14280 Carbide (also metal carbide)
- 14290 Tungsten carbide inserts and molded parts
- 14300 Carbide tools
- 14302 HM tipped saw blades
- 14304 HP grinding wheels
- 14306 Saw bands and blades for metallic and non-metallic materials
- 14310 Saw blades for metal
- 14318 Cutters
- 14320 Shear blades
- 14323 Splitting knives and accessories for splitting lines
- 14330 Abrasives and grinding wheels
- 14334 Special tools for die casting industry
- 14336 Cutting wheels
- 14337 Roll grinding wheels
- 14338 Cutting and special tools

**18.20. Clamping technology**

- 14380 Clamping hydraulics
- 14400 Clamping elements
- 14401 Clamping tools, screws

**18.21. Components**

- 14410 Seals
- 14412 Seals with high chemical and thermal resistance
- 14420 Rotary seals for feeding gases or liquid media
- 14430 Cooling water circulation units for continuous casting-rolling lines
- 14440 Nozzles (also blow-off and descaling nozzles)
- 14450 Pistons
- 14460 Metal hoses
- 14470 Buffers (rubber and cellular buffers)
- 14480 Stuffing box packings
- 14490 Wear plates

**18.22. Operating fluids**

- 14500 Solid lubricants
- 14510 Industrial oils
- 14520 Cooling lubricants

**18.23. Tribology**

- 14522 Dosing and monitoring equipment for lubricants

- 14523 Oil circulation systems for bearing and gear lubrication
- 14524 Two-line grease lubrication systems for metallurgical plants and rolling mills
- 14525 Special lubricants
- 14526 Central lubrication systems
- 14527 Machines for degreasing and lubrication

**18.24. Services**

- 14528 Service for compressors and turbines
- 14529 Mechanical processing of hydraulic parts

**19 Transport and storage technique**

- 14530 Engineering and technical assistance
- 14535 Hot material conveyors
- 14540 Transport and logistics for industrial residues
- 14545 Hot material conveyors
- 14548 Transport
- 14550 Transport technology

**19.01. Metallurgical plant vehicles**

- 14560 Slab, bloom and billet transporters, rubber tires
- 14570 Coil transport systems
- 14580 Coil transporters
- 14590 Steel mill vehicles, general
- 14600 Metallurgical plant vehicles, track-bound
- 14605 Air cushion vehicles-FTS
- 14610 Slag ladle transporters
- 14620 Slag transporter
- 14630 Scrap transport trailers with weighing equipment
- 14640 Steel mill vehicles

**19.02. Rail vehicles**

- 14650 Diesel locomotives
- 14660 Railroad wagons
- 14670 Self-propelled wagons

**19.03. Track technology**

- 14680 Turntables and transfer cars
- 14684 Track technology
- 14690 Shunting systems

**19.04. Trackless vehicles**

- 14700 Trailers
- 14705 Trucks and trailers
- 14720 Electric industrial trucks
- 14730 Electric trucks
- 14734 Electric four-way sideloaders
- 14740 Driverless transport systems
- 14742 Driverless transport systems for steel and aluminum coils
- 14750 Forklifts and cross stackers
- 14760 Rubber-tired heavy-duty transport vehicles
- 14810 Heavy-duty tractors
- 14820 Telescopic excavators
- 14822 Transport systems for coils

**19.05. Continuous conveyors**

- 14830 Conveyors (general)

- 14840 Pneumatic conveyors
- 14850 Vibratory conveyors
- 14860 Vertical conveyors
- 14880 Steep conveyors
- 14890 Continuous conveyors for bulk material
- 14900 Continuous conveyors for piece goods
- 14910 Conveyor belts and screws
- 14920 Trough chain conveyors

**19.06. Cranes**

- 14930 Slewing cranes
- 14940 Casting cranes
- 14945 Crane systems, automatic
- 14946 High capacity automatic cranes
- 14950 Cranes, hoists and accessories, general
- 14955 Crane service
- 14960 Overhead travelling cranes
- 14970 Gantry cranes
- 14980 Bracket cranes
- 14990 Buffers
- 14992 Vacuum lifting devices for heavy industry
- 14993 Automatic stacking devices (vacuum lifting devices)

**19.07. Scales**

- 14997 Bundle and coil scales
- 15000 Batching and blending scales
- 15010 Track and truck scales
- 15020 Crane scales
- 15030 Roller table scales
- 15040 Scales for continuous weighing
- 15041 Scales for alloying elements
- 15042 Scales for pig iron
- 15043 Scales for scrap
- 15044 Scales for static weighing
- 15045 Scales for stationary weighing
- 15050 Weighing systems for ladle turrets and ladle cars
- 15060 Load cells
- 15080 Weighing systems for silos

**19.08. Storage and retrieval systems**

- 15090 Bund high-bay warehouse
- 15100 Container staging systems
- 15110 Labeling systems
- 15120 Lattice girder storage systems
- 15130 Manual overhead conveyors
- 15134 Aerial work platforms
- 15140 Storage technology and automation systems for sheet metal, long goods and stacking boxes
- 15141 Storage technology and automation systems for sheet metal, long goods and stacking boxes
- 15150 Storage and retrieval systems
- 15155 Storage systems for coils
- 15160 Storage and racking systems
- 15164 Long goods order pickers, high rack stackers
- 15170 Marking systems
- 15180 Pallets and cassettes
- 15188 Vertical elevators (paternosters)
- 15190 Stacker cranes
- 15193 Traversers and turning devices
- 15195 Honeycomb racking systems

**19.09. Warehouse organization**

- 15198 Labels
- 15200 Identification
- 15208 Warehouse logistics
- 15210 warehouse organization)

**19.10. Components**

- 15220 Slings equipment
- 15230 Loading and unloading equipment
- 15240 Sheet metal package tongs
- 15250 block pushers, extractors
- 15270 Bunker discharge aid
- 15280 Bunker and silo equipment
- 15290 Coil and sheet metal packaging
- 15300 Coil tongs
- 15310 Permanent magnets
- 15320 Electrical equipment for cranes etc.
- 15330 Electric hoists
- 15333 Distance measuring devices for cranes
- 15335 Labels
- 15340 Conveyor belt cover
- 15350 Conveyor belt scraper
- 15360 Conveyor devices and equipment
- 15370 Conveyor belt splices
- 15380 Conveyor belt vulcanizing equipment and material

- 15390 Grippers and tongs
- 15400 Handling machines
- 15410 Lifting clamps, safety lifting clamps
- 15420 Industrial robots, metallurgical, sensor controlled
- 15430 Chains
- 15431 Sprockets
- 15440 Tipping eyes, tipping shackles
- 15450 Crane wheels
- 15455 Crane ropes
- 15460 Storage yard equipment
- 15470 Laser distance measuring devices for cranes

- 15480 Load lifting belts
- 15490 Lifting magnets and equipment
- 15500 Magnetic brakes
- 15510 Magnets, magnet systems
- 15511 EGIS safety device for electric lifting magnets
- 15520 Wheels
- 15530 Corrosion, friction and wear protection
- 15540 Bulk containers
- 15550 Pulleys
- 15555 Safety device for electric load lifting magnets

- 15560 Separation magnets
- 15570 Silos for FF-masses
- 15580 Silos for bulk materials
- 15590 Handling plants for bulk materials
- 15600 Deflection rollers
- 15610 Packaging technology
- 15620 Wear protection coatings with aluminum oxide ceramics
- 15630 Wear protection coatings with rubber
- 15632 Wear protection technology
- 15635 Track-bound tippers
- 15640 Wagon tipper
- 15650 Hot transport and cooling hoods for steel ingots
- 15652 Weighing systems for steel production

**19.11. Operating materials**

- 15660 Lubricants

**19.12. Packaging technology**

- 15662 Automated packing stations for coils and long goods
- 15664 Packaging materials

**20 Electrical engineering and automation**

- 15670 Electromechanical actuators
- 15680 Engineering and technical assistance
- 15690 Technical translations and documentation

**20.01. Electrical equipment for metallurgical plants and rolling mills**

- 15700 Workplace design systems
- 15720 Three-phase motors
- 15730 Electrical equipment for metallurgical plants and rolling mills
- 15740 Electrical equipment for rolling mills
- 15750 Large electrical installations, complete
- 15760 Power supply systems for mobile consumers
- 15770 Spring cable reels
- 15780 Spring hose reels
- 15785 Radio remote controls
- 15788 Radio systems
- 15790 Radio control systems
- 15800 Gear motors
- 15810 DC motors
- 15820 High current cables and lines, water cooled
- 15830 Cables and wires
- 15840 Cables, cable reels and accessories
- 15850 Motorized cable reels
- 15860 Low voltage switchgears and installations
- 15870 Switchgears
- 15880 Slip ring bodies
- 15890 Fuse systems
- 15900 Heavy current capacitors
- 15910 Plugs and socket-outlets
- 15920 Power converters (frequency converters)
- 15930 Power supply systems (movable and also busbars)
- 15940 transformers (also for industrial furnaces)
- 15960 AC and intercom systems
- 15962 High voltage feeders and contacts

**20.02. Control and automation systems**

- 15967 Electrical, instrumentation and control engineering, general
- 15968 Installations for anisotropic control technology
- 15970 Automation, general
- 15980 Automation plants for ore and fine ore
- 15990 Automation plants for blast furnaces
- 16000 Automation plants for industrial furnaces, general
- 16010 Automation plants for cold rolling mills
- 16020 Automation plants for coking plants
- 16030 Automation systems for steel mills
- 16035 Automation systems for blast furnaces

- 16040 Automation systems for hot rolling mills and tube mills
- 16041 Automation systems for hot rolling mills
- 16050 Automation plants and process control systems in metallurgical plants and rolling mills
- 16055 Automation of strip processing lines
- 16060 Automatic detection systems
- 16063 Strip guiding systems
- 16070 Data transmission equipment and systems
- 16080 Industrial television technology
- 16090 Information and communication systems
- 16100 Identification
- 16110 Customized complete systems
- 16120 Guidance systems (inductive) for vehicles
- 16130 Control systems (by image processing) for vehicles
- 16140 Control and automation systems, general
- 16150 Positioning systems for cranes
- 16160 Process automation
- 16162 Process automation for strip processing lines
- 16170 Process automation for continuous steel casting plants
- 16180 Process automation for metallurgical plants
- 16190 Process control systems
- 16192 Process control with infrared detectors
- 16200 Process optimization
- 16202 Process optimization with weighing systems
- 16205 Shopfloor systems
- 16210 Control systems, complete
- 16220 Control stations for metallurgical and rolling mill plants
- 16230 Control systems, electrical
- 16240 Control systems, electronic
- 16250 Control systems for press water tanks
- 16260 Control systems, hydraulic
- 16270 Control systems, infrared
- 16280 Power supplies for automation and control
- 16290 Networking
- 16293 Video technology
- 16295 Weighing systems for process automation in steelworks

**20.03. Data processing**

- 16300 Analog devices and accessories
- 16305 Archiving
- 16310 Production and machine data acquisition BDE/MDE
- 16320 Data acquisition devices and systems
- 16330 Data processing
- 16338 Digital image processing
- 16340 Digital devices and accessories
- 16350 Expert systems
- 16355 Manufacturing Execution System (MES)
- 16360 Turnkey system solutions, hardware \ 057software
- 16380 X-Window Terminal

**20.04. Software**

- 16390 Simulation software
- 16393 Software for archiving, document management and workflow

- 16395 Software for order processing, warehouse and test certificate management
- 16400 Application software
- 16410 Software for slitting lines
- 16415 Enterprise resource planning system for metal and steel trade
- 16420 Software for production planning and control
- 16430 Software for statistical process control and quality assurance
- 16440 Technical calculation programs
- 20.05. Maintenance**
- 16450 Machine diagnostics
- 16460 Maintenance and inspection

**21 Measuring and testing technique**

- 16470 Gas measuring instruments for degreasing plants
- 16472 Gas measuring devices for metal degreasing plants
- 16480 Gas measuring devices for metal cleaning plants
- 16488 Multichannel measuring systems

**21.01. Measuring and testing technology, general**

- 16490 Automation and metrology, color measurement
- 16500 Pressure transducers
- 16508 Corrosion testers
- 16510 Metrology
- 16511 Measuring magnetism
- 16520 Measuring and testing systems, general
- 16530 Measuring and testing systems, general
- 16540 Measurement value acquisition
- 16550 Measured value processing
- 16552 Measuring and test equipment identification labels
- 16553 Measuring equipment and test status identification labels
- 16560 Radioactivity warning systems
- 16564 Recorder systems, paperless
- 16566 Pre-warning of melt breakthroughs and residual wall thickness measurement on refractory linings
- 16568 Roll gauges

**21.02. Measurement of physical properties**

- 16570 Distance measuring system
- 16580 Distance sensors for positioning and length measurement (laser, ultrasonic, optical, inductive and capacitive)
- 16581 Distance sensors for positioning and length measurement (magnetostrictive)
- 16590 Bath mirror measurement in converter
- 16600 Bath mirror control
- 16608 Strip thickness control (AGC)
- 16610 Strip sag measuring device
- 16612 Strip flatness measurement
- 16613 Strip flatness control
- 16615 Strip guiding system
- 16620 Tape tension measuring systems

- 16625 Tension measuring system for driven S-rolls
- 16630 Width measuring devices
- 16640 Strain gauges and measuring strips
- 16645 Strain measuring systems
- 16650 Strain and mass flow measuring systems
- 16652 Dressing degree and mass flow measuring systems
- 16660 Thickness measuring systems and devices
- 16670 Thickness gauges
- 16680 Distance switches and measuring devices (optical, acoustic and inductive)
- 16690 Torque measuring devices for S-rollers
- 16700 Torque measuring device
- 16710 Speed measuring devices
- 16720 Flow meters
- 16721 Flow measuring devices, capacitive, e.g. for coal injection
- 16730 Flow monitoring
- 16740 Diameter measurement
- 16750 Electrical measurement of mechanical quantities
- 16755 Electronic measuring system for hydraulic and lubricating oils
- 16770 Form measurement
- 16780 Level measuring devices
- 16790 Level control
- 16800 Level control
- 16810 Gas measuring instruments
- 16815 Oxygen sensors for waste gas
- 16820 Equipment and chemicals for waste water control
- 16830 Speed measuring devices
- 16850 Infrared switch
- 16860 Infrared radiation pyrometer
- 16861 Infrared radiation thermometer with scanner
- 16870 Infrared radiation pyrometer with scanner
- 16871 Infrared Radiation Thermometer
- 16875 Infrared thermography
- 16877 IR camera - infrared based slag detection
- 16878 Cameras, furnace cameras
- 16879 Cast iron temperature measurement
- 16880 Insulating capillary
- 16890 Force measuring devices for tension and compression
- 16891 Force measurement and weighing systems
- 16892 Force measuring systems
- 16900 Cooling water monitoring
- 16910 Length measuring devices for tubes
- 16920 Linear encoders
- 16930 Linear encoders (also for ways and distances)
- 16940 Linear encoders, ultrasonic (also for ways and distances)
- 16950 Length and speed measuring systems (optical)
- 16960 Laser speed and length measuring systems
- 16970 Conductivity and pH meters
- 16980 Mass flow meters
- 17000 Measurement of refractory linings (in operating condition)
- 17010 Measuring devices for electrical quantities
- 17020 Measuring machines

- 17030 Measurement printers
- 17033 Microstructure/roughness measurement
- 17035 Surface crack detection
- 17040 Opto-electronic measuring instruments
- 17050 Flatness measuring devices
- 17057 Profile measuring devices
- 17060 Profile measuring systems (non-contact)
- 17080 Pyrometer
- 17090 Pyrometer tubes
- 17100 Ratio pyrometer
- 17105 Inline concentration measurement of liquids
- 17110 Probes for liquid pig iron
- 17120 Tube measuring equipment
- 17130 Coating thickness gauges
- 17133 Coating thickness control
- 17135 Layer thickness control
- 17138 Slag detection with infrared
- 17140 Slag detectors
- 17160 Forging measurement
- 17180 Vibration measuring devices
- 17190 Rope testing equipment for round and flat steel ropes (rope belt conveyors)
- 17200 Dust measuring equipment
- 17210 Equipment for radiation measurements
- 17220 Systems for nuclear radiation measurement (input control)
- 17230 Immersion thermocouples
- 17250 Temperature measurement equipment
- 17255 Temperature profile measuring systems
- 17260 Thermocouples
- 17270 Thermocouple protection tubes
- 17274 Thermographic measurement
- 17280 Thermal conductivity measuring systems
- 17290 Rolling mill force measuring systems
- 17300 Rolling mill measuring systems
- 17310 Resistance thermometers
- 17320 Line scan cameras
- 17322 Non-destructive thickness measurement of refractory linings (during furnace shutdown)
- 17325 2-color pyrometer with fiber optics

**21.03. Quality management**

- 17340 3-D profile measurement of rails and other profiles
- 17341 3-D profile measurement of weld seams
- 17345 Pickling bath monitoring
- 17350 Breakdown early detection
- 17352 Breakdown early detection and monitoring
- 17360 Breakdown monitoring
- 17365 Chrome bath monitoring
- 17368 Roller emulsion control
- 17370 In-line surface inspection, optical
- 17380 Measuring instruments for quality management
- 17384 Mold control
- 17390 Length, speed and profile measuring systems
- 17400 Hole detection
- 17408 Surface inspection
- 17409 Surface inspection systems
- 17410 Surface inspection
- 17415 Surface inspection of strip steel
- 17426 On-line measurement of oils and waxes
- 17430 On-line surface inspection, optical
- 17432 On-line surface quality inspection, optical

- 17440 On-line roughness measurement
- 17445 Systems for quality data acquisition and processing

**21.04. Quality control**

- 17446 Strip edge inspection
- 17447 Strip steel surface inspection, automatic and complete
- 17448 Strip steel surface inspection, automatic and complete
- 17450 Quality control, visual
- 17460 Testing services

**21.05. Services**

- 17470 Metrology services

**22 Materials testing**

- 17473 Destructive and non-destructive materials testing

**22.01. Non-destructive materials testing**

- 17480 Consulting, execution, equipment
- 17490 Image processing, barcode readers
- 17500 Demagnetization equipment
- 17510 Internal pressure testing equipment
- 17520 Corrosion testing
- 17530 Measuring and testing machines
- 17536 Training and certification for NDT
- 17540 Ultrasonic testing equipment/machines
- 17560 Non-destructive testing of round and flat steel cables
- 17570 Non-destructive pipe testing equipment
- 17580 Non-destructive material testing equipment, general
- 17589 Non-destructive material testing equipment, acoustic
- 17590 Non-destructive material testing equipment, electromagnetic
- 17620 Non-destructive material testing equipment, optical
- 17630 Non-destructive materials testing with X-rays
- 17640 Non-destructive materials testing with acoustic emission analysis
- 17650 Non-destructive materials testing equipment with ultrasound
- 17660 Non-destructive materials testing
- 17664 Non-destructive materials testing with fluorescent and red/white penetrant methods
- 17665 Non-destructive material testing with fluorescent and red/white test method
- 17670 Non-destructive materials testing with coupling agent-free ultrasonic excitation
- 17680 Non-destructive materials testing, optoelectronic
- 17690 Non-destructive materials testing (service)

**22.02. Strength testing, endurance testing**

- 17698 Fixtures for tensile testing
- 17700 Stress analyses and reliability tests on machines and components
- 17710 Consulting, execution, equipment
- 17720 Fatigue testing machines

- 17730 Hardness testers
- 17740 Hardness testing equipment
- 17750 Machines for tensile test preparation
- 17760 Friction and wear testing machines
- 17770 Crack testing machines
- 17780 Pipe testing presses
- 17790 Torsion testing machines
- 17800 Universal testing machines for tension, compression, bending and tensile tests

**22.03. Technological testing methods, testing service**

- 17810 Chemical analyses
- 17820 Grain size analysis
- 17830 Mechanical-technological testing
- 17840 Metallographic testing
- 17850 Technological testing
- 17852 Technological testing, microscope image analysis
- 17860 Deep drawing testing machines for sheets and strips
- 17870 Conversion of conventional universal testing machines to electronic measurement with data processing
- 17880 Roll testing (concentricity, eccentricity)

**22.04. Destructive material testing**

- 17888 Corrosion testing
- 17890 Machines for the production of notched bar impact specimens

**22.05. Fatigue testing**

- 17896 Testing of safety valves in operating condition

**22.06. Damage analysis**

- 17898 Damage analysis

**23 Analysis and laboratory equipment**

- 17900 Engineering and technical assistance

**23.01. Sampling and sample preparation**

- 17910 Gas probes, gas sampling probes
- 17915 Sampling
- 17920 Sampling equipment
- 17940 Sample punching
- 17950 Sample transport
- 17960 Sample preparation
- 17970 Sample preparation for X-ray fluorescence analysis
- 17980 Sample preparation for OES and XRF (X-ray testing)
- 17990 Sample preparation machines
- 18000 Spectrometer sample preparation with remelting equipment
- 18010 Punching tools for samples

**23.02. Analytical equipment**

- 18020 Analytical instruments
- 18022 Devices for inline concentration measurement of liquids
- 18025 Analyzers for oxygen measurement

- 18027 Automated analyzers for process control and wastewater management
- 18030 Automation equipment for analysis and laboratory
- 18040 Gas analyzers
- 18048 Laser induced fluorescence
- 18050 Laser plasma spectrometer
- 18059 Mass spectrometers
- 18060 Conductivity and pH measuring instruments
- 18070 Oil-in-water monitoring in the laboratory and in industry
- 18080 Optical emission spectrometers
- 18090 O2 analyzers
- 18100 Plasma spectrometers
- 18105 X-ray diffractometers
- 18110 X-ray fluorescence spectrometer
- 18120 X-ray fluorescence spectrometers, portable
- 18130 Oxygen probes
- 18138 Heavy metal analysis in water, laboratory, field, process and online
- 18140 Nitrogen analyzer system for direct determination
- 18150 Nitrogen probes
- 18160 Hydrogen analysis system for direct determination
- 18170 Hydrogen probes
- 18180 Accessories for analytical technology

**23.03. Laboratory equipment, general**

- 18190 Analytical standards
- 18200 Analytical reference material
- 18202 Equipment for sample preparation for OES and XRF (X-ray testing)
- 18210 Calibration samples
- 18220 Annealing boxes
- 18230 Laboratory furnaces
- 18240 Laboratory equipment
- 18250 Laboratory automation
- 18260 Shuttles
- 18264 Shuttles and HF crucibles for C+S determination
- 18270 Spectral samples
- 18280 Crucibles

**23.04. Metallography**

- 18290 Services
- 18300 Metallography equipment
- 18310 Metallographic laboratories
- 18320 Metallographic testing

**24 Environmental protection and disposal**

- 18330 Consulting and measurement
- 18340 Engineering and technical assistance

**24.01. Dedusting and gas cleaning**

- 18342 Exhaust gas technology
- 18348 Oxygen sensors for exhaust gas
- 18350 Exhaust systems
- 18360 Exhaust gas cooling systems
- 18362 Exhaust gas cooling with heat recovery
- 18370 Exhaust gas cleaning systems

- 18375 Secondary exhaust gas cleaning systems
- 18376 Sintered exhaust gas cleaning systems
- 18377 Desulfurization of sinter flue gases
- 18378 Exhaust gas cleaning for pellet plants
- 18380 Waste heat boiler
- 18390 Aerosol separation
- 18400 Treatment of dusts from steel mills and foundries
- 18410 Electrostatic precipitator
- 18420 Dedusting and gas cleaning
- 18430 Dedusting plants and accessories, general
- 18440 Dedusting filters and plants (cassette, cartridge, round, bag, pocket filters, etc.)
- 18450 Denitrification plants
- 18460 Denitrification catalysts (DENOX)
- 18470 Fine dust removal for sinter plants
- 18480 Filter media
- 18490 Gas recovery plants
- 18500 Fabric filters
- 18510 Casting shop dedusting
- 18515 Blast furnace exhaust gas cleaning
- 18520 Hot gas filtration
- 18530 Industrial vacuum cleaners
- 18535 Catalytic plants
- 18536 Catalyst service
- 18540 Compact air cleaner
- 18550 Laser Clean Box
- 18560 Air filters (also in-line filters)
- 18570 Multicyclones and cyclones
- 18580 Afterburning, catalytic
- 18590 Afterburning, thermal
- 18600 Wet dust collectors
- 18608 Wet dedusting systems
- 18610 Wet fine dust removal for sinter plants
- 18615 Wet electrostatic precipitators
- 18620 Wet cleaning plants
- 18630 Flue gas desulfurization for boiler and sinter plants
- 18640 Flue gas cleaning plants for waste and hazardous waste incinerators
- 18650 Dust collectors
- 18660 Dust measuring devices
- 18670 Dust recovery plants
- 18690 Thermal exhaust air purification
- 18693 Dry exhaust gas cleaning plants
- 18700 Dry dedusting plants (also rotary flow dedusters)
- 18710 Dry cleaning plants
- 18720 Venturi dust collectors
- 18728 Central exhaust systems
- 18730 Central dust extraction plants

**24.02. Waste water treatment**

- 18740 Waste water plants, grease separators, chemical pumps
- 18750 Waste water treatment
- 18755 Waste water treatment, thermal
- 18756 Wastewater treatment for wastewater containing oil and grease
- 18760 Wastewater treatment plants
- 18770 Chemical water treatment
- 18774 Evaporation plants
- 18790 Wastewater treatment plants
- 18800 Recirculation systems
- 18802 Recirculating water treatment
- 18810 Solvent recovery plants
- 18820 Neutralization and detoxification plants

- 18830 Sludge dewatering, mobile
- 18840 Sludge dewatering, stationary
- 18842 Water management

**24.03. Regeneration plants**

- 18870 Regeneration plants for pickling solutions
- 18880 Acid resistant collection cups and wall coatings with DIBt test mark
- 18890 Sand regeneration plants

**24.04. Recycling and waste disposal**

- 18900 Exhaust air purification
- 18910 Remediation of contaminated sites
- 18920 Plants for the recycling of raw materials (dusts)
- 18921 Plants for the recycling of residual materials
- 18922 Car recycling plants
- 18923 Electric arc dust recycling
- 18925 Biological exhaust air treatment
- 18930 Soil and groundwater remediation
- 18940 Flaring plants, thermal afterburning
- 18970 Injection plants for filter dust
- 18975 Injection plants for alloy and residual materials using oxygen burners
- 18980 Storage of substances hazardous to water
- 18990 Oil and grease removers
- 18997 Radioactive substances
- 19000 Residue-free vibratory grinding
- 19005 Slag processing (slag transport and recycling)
- 19009 Chimney construction
- 19010 Chimneys (also sheet metal chimneys)
- 19020 Separation of non-ferrous metals
- 19045 Plants for preparation and recycling of metallurgical residues
- 19050 Other disposal plants
- 19060 Recycling of residual materials (ashes, slags, dusts, sands)
- 19070 Rolling mill slag de-zincification
- 19072 Dezincification of metallurgical dusts
- 19080 Recovery of recyclable materials
- 19090 Fluidized-bed drying of steel mill sludges

**24.05. Components**

- 19110 Separators (gasoline, benzene, oil, water)
- 19114 Aerators and agitators
- 19120 Emulsion splitting plants
- 19130 Injection plants for processed, oil-containing mill scale sludges
- 19140 Injection plants for Carbo Fer
- 19150 Injection plants for PE granules
- 19160 Heat exchangers

**24.06. Operating materials**

- 19170 Activated carbon
- 19180 Lignite coke
- 19190 Oil binder
- 19200 Lubricants

**24.07. Services**

- 19210 Exhaust gas measurements
- 19220 Chemical and mineralogical analysis
- 19230 Emission measurements
- 19232 Simulation software for exhaust gas measurement with design and optimization of exhaust systems



**25 Occupational safety and ergonomics**

- 25.01. Occupational safety**
- 19240 Occupational safety clothing
- 19260 Respiratory protection masks
- 19263 Fire blankets for welding work made of textile fabric
- 19266 Fire blankets and containers
- 19270 Gas detectors
- 19280 Heat protective clothing
- 19285 High temperature resistant and fireproof textile products
- 19289 Protective glass
- 19290 Industrial protective glass
- 19300 Light curtains for accident prevention and other applications
- 19305 Soldering protection mats made of textile fabric
- 19310 Furnace sight glass Neotherm®
- 19320 Safety edges
- 19330 Safety mats
- 19340 Welding protection glass Athermal®
- 19350 Welding accessories
- 19360 Dust measuring devices
  
- 25.02. Noise protection devices**
- 19368 Hearing protection
- 19370 Noise reduction
- 19380 Industrial noise protection
- 19390 Noise protection devices
- 19400 Noise monitoring
- 19410 Level recorder
- 19420 Sound insulation
- 19430 Sound level meter
- 19432 Sound insulation

**26 Other products**

- 19440 Aluminium and zinc slug production
  
- 26.01. Foundry products**
- 19450 Stainless steel mold casting
- 19460 Stainless steel shell mold casting
- 19470 Stainless steel centrifugal casting
- 19490 Investment casting by the lost wax process
- 19500 Cast iron with spheroidal graphite (ductile iron)
- 19510 Cast iron with lamellar graphite (gray cast iron)
- 19520 Cast iron shape casting
- 19530 Continuous cast iron
- 19540 Chilled cast iron
- 19550 Heat resistant cast iron
- 19560 Gravity die casting
- 19570 Copper and copper alloy castings
- 19580 Light metal castings
- 19590 Machine mold casting
- 19610 Acid resistant castings
- 19630 Centrifugal casting
- 19640 Heavy metal casting
- 19660 Steel casting
- 19670 Wear-resistant casting

**27 Consulting, planning and services**

- 19695 Hot tapping under pressure
- 19700 Fittings service
- 19710 Training and further education of welding personnel
- 19715 Consulting, planning and services
- 19720 Consulting services
- 19721 Consulting for optimization of weighing systems
- 19730 Consulting service
- 19731 Procurement, eProcurement
- 19734 blended learning
- 19740 Services, quality assurance
- 19750 Emission measurements
- 19760 Energy consulting
- 19770 Energy saving
- 19780 Energy service (optimization, recovery, supply)
- 19790 Decoating
- 19792 Spare parts for commissioning
- 19794 Commissioning
- 19810 Engineering services (also commissioning of metallurgical plants as well as conveyor and drive technology plants)
- 19815 Engineering problem solving
- 19820 Maintenance organization
- 19822 Cooling and boiler water treatment
- 19824 Lean management
- 19825 Leak sealing under operating pressure
- 19830 Logistics consulting
- 19832 Logistics services, steel logistics
- 19840 Contract annealing
- 19850 Contract annealing (own mobile annealing facilities)
- 19860 Management consulting
- 19875 On-site machining (milling, drilling, turning, grinding, etc.)
- 19880 Assembly and maintenance
- 19890 Marketing services
- 19892 Offline Maintenance
- 19893 Online Maintenance
- 19895 Quality management consulting
- 19900 Experts
- 19910 Cutting and welding consulting
- 19920 Welding research and education
- 19930 Simulation studies and software
- 19935 Software for metalworking
- 19940 Supplier of spare parts, equipment and accessories for the steel industry, general
- 19950 Radiation
- 19952 Radiation protection
- 19955 supply chain management
- 19960 Digitalization consulting
- 19970 Software solutions for digitalization
- 19980 Digitization analysis
- 19990 Technical translations and documentation
- 20000 Training and commissioning of metallurgical plants
- 20005 Management consulting
- 20010 Leasing of electronic measuring equipment, data technology and computers
- 20015 Continuing education
- 20016 Continuing education - refractory
- 20020 Certifications

**28 Steel in civil engineering**

- 28.01. Software for building and construction**
- 20050 Cad software
  
- 28.02. Steel in building construction**
- 20058 Structural steel
- 20070 Hall gates
- 20086 Pipelines
  
- 28.03. Steel in civil engineering**
- 20100 Offshore technology
- 20106 Tubes
- 20108 Micropiles
- 20110 Anchorages
- 20112 Sheet piling

**30 Service concerning steel materials**


- 20135 Processing services
  
- 30.01. Joining**
- 20178 Soldering

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### STEEL TECHNOLOGY

#### Optimising input of raw materials with emphasis on CO<sub>2</sub> reduction

Austrian stainless steel company Breitenfeld Edelstahl launched a digital transformation project in 2021. In this context, a new type of raw material optimisation software was introduced. Here, a sophisticated mathematical algorithm combined with metallurgical intelligence enables optimization of raw materials use. Shortly after implementation, cost savings were quickly realised, which helped to cover the investment of the entire digitalisation project.

#### Impact on the quality of heavy plate after heat treatment

The specifications for heavy plate in terms of strength and wear resistance have increased considerably with the development of new steel grades. Depending on the application and the plate geometry, the heat treatment must be individually adapted. The cooling rate during solidification as well as micro elements and impurities influence the brittleness during tempering and have an impact on the plate quality.

### STEEL DISTRIBUTION

#### Successful implementation of an interface for the steel preprocessing in the online shop

To remain successful, companies need to digitalise and automate their processes. Recently, German steel distributor G. Elsinghorst Stahl und Technik GmbH realised another digitalisation project and successfully connected the online shop via ERP interface with the merchandise management system of the steel trade business.

### STEEL PROCESSING

#### Combined 2D and 3D surface inspection system at a pickling line

The combination of two highly efficient Surcon units installed in a single measuring system enables German tin plate manufacturer thyssenkrupp Rasselstein to further reduce the occurrence of rolling damages and strip breaks.

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A large industrial steel mill facility, featuring a tall, complex structure of pipes and scaffolding, likely a blast furnace, and a tall, cylindrical chimney. The scene is set against a blue sky with some clouds. The foreground shows a dirt area with some equipment and materials.

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