EFFICIENT STRIP PROCESSING LINES FROM THE SYSTEM SUPPLIER

For more than 60 years SMS group has been designing, erecting and commissioning processing lines for carbon steel, electric steel, stainless steel and aluminum strip. Today, the comprehensive product range includes all the necessary plants for highest product quality. Common to all lines is the high cost-efficiency that results from constant improvement, quality consciousness and a focus on saving resources.

Drawing on the combined strength of the companies in SMS group, the lines can be supplied from one single source. In this brochure you will find comprehensive information about our products, technologies, services and references regarding strip processing lines and strip processing equipment.
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HIGHLIGHTS

NUMEROUS REFERENCES

Since 2000, SMS group has attracted orders for much more than 150 strip processing lines for carbon steel, silicon steel, stainless steel and aluminum including all important line types.

EXAMPLES OF METAL PRODUCERS USING SMS STRIP PROCESSING TECHNOLOGY

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<thead>
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<th>Examples</th>
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<td>Baoshan Iron &amp; Steel</td>
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</tbody>
</table>
MARKET LEADERSHIP
The majority of market leaders among metal producers rely on SMS group technology.

HIGH PRODUCT QUALITY
Significant for all processing lines is the high quality of the final product. Thus, the processing lines are specially equipped to ensure flawless surfaces and homogenous material characteristics.

FLEXIBLE PRODUCTION
Flexible production conditions allow quick reaction to changing market demands with the greatest economic efficiency. SMS group has built several multi-purpose lines with changeable process routes.

SYSTEM SUPPLY
SMS group is capable of delivering almost all lines completely from one single source. This means that you get everything you need from one supplier, without any interface problems.

PRODUCTION KNOW-HOW
SMS group offers process support for all materials and quality grades. This covers both metallurgical and design activities as well as support during commissioning, operation, quality control and certification.

ECOPLANTS
All strip processing lines are designed to keep resource consumptions as low as possible. All technologies and processes are continuously evaluated in order to improve eco-friendliness.

PROJECT MANAGEMENT
Professional project management according to the latest knowledge and international standards ensures consistent and reliable fulfillment, in combination with modern design methods.

MANUFACTURING
The set-up includes several modern and well-equipped manufacturing locations worldwide to ensure a high level of quality control and short distances to the customers.

MODERNIZATIONS
Comprehensive services and experience for revamps. Starting from the replacement of single machines up to major revamps of complete plants using several measures.

INDUSTRY 4.0
SMS group uses intelligent production and process models for strip processing lines which are deeply integrated in the automation system and are coupled with each other.
STRIP PROCESSING IS BASED ON PROCESSES

Strip processing line technology is driven by processes aimed at enhancing the material quality, and thus the value of the material, step by step. SMS group has extensive know-how and understanding of all important process steps. Depending on the different materials, SMS has developed special solutions to fulfill all special requirements.

Pickling
Carbon steel / silicon steel / stainless steel / aluminum

Annealing & cooling
Carbon steel / silicon steel / stainless steel / aluminum

Tension leveling & skin-passing
Carbon steel / silicon steel / stainless steel / aluminum
Hot-dip galvanizing
Carbon steel

Electrolytic coating
Carbon steel

Color and chemical coating
Carbon steel / silicon steel / aluminum
# PRODUCT PORTFOLIO – OVERVIEW

<table>
<thead>
<tr>
<th>Strip Processing Lines</th>
<th>Pickling Line / Tandem Cold Mills (PLTCM)</th>
<th>Continuous Pickling Lines (CPL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon steel hot-strip lines</td>
<td><img src="image1.png" alt="Image of Carbon steel hot-strip lines" /></td>
<td>See Pages 26-37</td>
</tr>
<tr>
<td>Carbon steel cold-strip lines</td>
<td><img src="image2.png" alt="Image of Carbon steel cold-strip lines" /></td>
<td>Continuous Galvanizing Lines (CGL)</td>
</tr>
<tr>
<td>Continuous Annealing Lines (CAL)</td>
<td>See Pages 40-55</td>
<td></td>
</tr>
<tr>
<td>Silicon steel strip lines</td>
<td><img src="image3.png" alt="Image of Silicon steel strip lines" /></td>
<td>Annealing &amp; Coating Lines (ACL)</td>
</tr>
<tr>
<td>Annealing &amp; Pickling Lines (APL)</td>
<td>See Pages 68-69</td>
<td>See Pages 70-73</td>
</tr>
<tr>
<td>Stainless steel strip lines</td>
<td><img src="image4.png" alt="Image of Stainless steel strip lines" /></td>
<td>Hot-Strip Annealing &amp; Pickling Lines (HAPL)</td>
</tr>
<tr>
<td>Cold-Strip Annealing &amp; Pickling Lines (CAPL)</td>
<td>See Pages 74-81</td>
<td></td>
</tr>
<tr>
<td>Aluminum strip lines</td>
<td><img src="image5.png" alt="Image of Aluminum strip lines" /></td>
<td>Heat &amp; Chemical Treatment Lines (HCTL)</td>
</tr>
<tr>
<td>Heat Treatment Lines (HTL)</td>
<td>See Pages 82-93</td>
<td></td>
</tr>
</tbody>
</table>
Besides these main lines, SMS group offers various other line concepts or variations of processes depending on the individual customer requirements. Revamps or integration of single components also belong to the product portfolio (see Page 22). Furthermore, smaller lines such as electrolytic cleaning lines (ECL), tension leveling lines (TLL) or recoiling lines (RCL) can also be delivered. Process technological plants such as acid regeneration or hydrometallurgical plants complete the comprehensive portfolio.
SYSTEM SUPPLIER

SMS group is the only company worldwide capable of delivering strip processing lines as a full system supplier. That’s because all products and services are available within the SMS group – from mechanical and process components through furnaces to electrical and automation, control and measuring systems, and all the associated know-how.

**MECHANICAL EQUIPMENT**
- Terminal equipment
- Skin-passing mills
- Tension levelers
- Side trimmer units
- Cross-cutting shears
- Strip accumulators

**PROCESSES**
- Cleaning sections
- Pickling sections
- Galvanizing sections
- Coating sections
- Tinning sections
- Electrostatic oilers

**FURNACES**
- Full-radiant tube furnaces
- Direct-fired furnaces
- Inductive heating
- Floatation furnaces
- Catenary furnaces
- Flattening furnaces
- Decarburization furnaces

SMS group is capable of delivering strip processing lines with all necessary components and services from one source.
ADVANTAGES DUE TO COMPLETE SYSTEM SUPPLY:

- Perfect match of all components
- Clear responsibility
- One face to the customer
- Fast start-up

ELECTRICAL AND AUTOMATION

- Levels 1 to 3
- Process and production models
- Strip steering systems
- Quality monitoring systems
- Measuring systems
- Plug & Work integration tests
- Operation and visualization systems

SPECIAL SERVICES

- Production know-how
- Start-up assistance
- Continuous production assistance and process optimization
- Qualification assistance
- Certification and approval assistance
- After-sales service
- Revamps and modernizations
MANUFACTURING EXPERTISE worldwide

Maintaining its long-term commitment to Germany as an engineering and production location while also driving the international expansion of our production, SMS group is perfectly positioned to meet the challenges of the global market for metallurgical plants and machinery.

One key factor here is our dense manufacturing and workshop network around the world. We will continue to produce the most complex machinery and plant components in our German facilities – at the uppermost level of technology and with know-how that has grown over decades. Essential to preserving
this status is our continuous investment in the expansion and modernization of these production plants.

Simultaneously, we are building up even more our international workshop, service and production capacities. Here, it is all about special products geared to the local market that we can manufacture there at competitive prices. What’s more, our presence on the ground ensures that customers and partners can rely on fast, no-fuss service – today and in the future. Added to this is the benefit that third-party companies can use our production shops for having drive and hydraulic system parts assembled. There is a continuing focus on committing ourselves to our German production locations, yet we combine this principle with a global approach that ensures we are close to you and your markets. This has been a hallmark of our company for more than 140 years. It all started in 1904 when our plant in the Siegerland region of Germany built, for example, wagons for the coalmines in China. Today, the "Middle Kingdom" is one of our most important markets, where we operate not only an extensive service network, but also our own production locations.

That also means closely linking our engineering and production. Our engineers know all there is to know about current and future requirements in the steel, aluminum, and NF metals industries. As a systems supplier, we cover the entire process chain including electrical and automation systems, and services.
PROJECT MANAGEMENT

PROJECT BUSINESS
TO IMPLEMENT COMPLEX PLANT CONSTRUCTION CONTRACTS

In international plant construction, "best-in-class" project management is a main objective of the SMS group. It is in the nature of business that project management at SMS has high priority. Metallurgical plant construction is characterized by highly individual customer requirements. The complex plants are often realized in an international setting with many different participating parties. High investment costs, long running times, dynamically changing boundary conditions as well as risk potentials that should not be underestimated, all require professional project management in order to achieve project goals and ensure customer satisfaction.

PROJECT HANDLING
"IN TIME, IN QUALITY, IN BUDGET"

At SMS a professional project management system has been established, that ensures the best possible handling, "in time, in quality, in budget". As a company within the small and medium-size category, SMS always places great value on rapid decision-making processes and unbureaucratic, flexible activities. Clear rules for the whole handling process allow the contractual services to be made available to the customers on schedule and in high quality. The primary aim here is always: to achieve an optimum economic solution for the customer by means of technological leadership in plants and systems.

Rapid decision-making processes and unbureaucratic activities are important cornerstones of the handling of strip processing lines.
CONSTANT FEEDBACK AND CONTINUOUS PROCESS OPTIMIZATION

The project management of SMS comprises classic methods which are specially adapted to the company requirements. Furthermore, methods and systems are constantly checked and project experiences are integrated for continuous improvement. By doing this we ensure that the degree of refinement of the project management is constantly expanding in line with the increasing requirements. Besides the general planning and control methods, our project leaders work with project management tools and systems that are individually tailored to the plant engineering, so as to adequately control and monitor the projects. Modern software, from SAP and Microsoft for example, is still used to ensure compatibility for our customers. Moreover, continuous monitoring of results is integrated. Using a perfected "Lessons Learned" process, we ensure a constant feedback of experience from practice and provide an important contribution to the continuous improvement process.

PROJECT MANAGERS AS "TEMPORARY ENTREPRENEURS"

Well-trained project managers who have the necessary competences and have access to the necessary resources are at the heart of successful project management. At SMS the project managers are seen as "temporary entrepreneurs". The human resources development process continually identifies new, talented individuals for project management, who are characterized by entrepreneurial spirit and structured procedures in addition to personal aptitude. These employees are introduced to the complex tasks of this area of work by methodical, multi-stage project management training.

The project management is the main point of contact for customers.
ELECTRICAL AND AUTOMATION SYSTEMS

INTEGRATED SOLUTIONS

SMS group provides integrated solutions including electrical and automation systems for all strip processing lines. They are jointly designed to implement the advanced technology required for the production of the envisaged first-class materials.

Therefore, electrical and automation systems are integrated into all activities regarding engineering, commissioning or research and development. The same models which are used to design the line are within the process automation used to operate the line. This is an essential benefit for our customers, especially with regard to after-sales service and for future product development.

X-PACT® MODULAR AUTOMATION PACKAGES

Electrical and automation systems are a crucial success factor in the realization of complex plants. This is where everything comes together for controlling, monitoring, checking, evaluating and coordinating the plant. As a holistic electrical and automation package, X-Pact® makes sure all plant parts mesh with each other and work smoothly together: from energy supply and distribution through drive technology, instruments and automation, and production planning. All electrical and automated functions included in X-Pact® are performed by globally available components of modular design. That ensures standardized solutions for all tasks – carefully worked out according to international standards. This guarantees you maximum reliability, service, and independence in production. And furthermore, it helps you make any necessary adjustments in next to no time.

The X-Pact® production planning and control system provides you with all the tools you need for effective planning and quality assurance for the processes in your metallurgical plant and rolling mill.

GENERAL PRODUCTS

- Production Planning Systems (PPS)
- X-Pact® Energy Advisor
- X-Pact® Plant Condition Advisor
- New plant operation concept
- Holistic solution for the operating areas
- X-Pact® Drive
- Web-based reporting
- Wireless LAN operation
- Upgrade package
- Virtualization

Where everything comes together: Pulpit in a modern strip processing line.

All processes are simulated and optimized during the Plug & Work integration test.
Plug & Work Integration Test

Test field installation of the complete automation system
Simulation and optimization of the production process
Training of customer staff at the test field
Fast commissioning

The Plug & Work test reduces the commissioning times significantly. Prior to commissioning on site the automation is built up in a test field where all production sequences are simulated. By doing this it is possible to test and optimize the automation software under realistic conditions and train the customer’s staff.

The customer’s staff are trained under realistic conditions prior to commissioning.
OPERATION AND VISUALIZATION SYSTEMS

PLANT OPERATION MADE EASY

Overwhelming quantities of data and information arise in steel and rolling mills today. With the right concept in place, plant operators are on the safe side. SMS group has the right solution.

In production plants, the number of sensors and actuators utilized is constantly growing. So is the degree of automation. However, the sophistication of the technology does not make the human operator redundant. All the information converges in the control room. SMS offers an ideal integrated solution, taking into account the control room and the HMI. An initial characteristic of this solution is the clear separation between an operating area and a social/analysis area. During production, people in the operating area must be highly concentrated and may by no means be distracted. By contrast, the social or analysis area serves as a meeting place for colleagues, customers and visitors. Here, production results can be analyzed and presented without having to actively interfere with the actual production process.

THE OPERATING AREA

The core of the control pulpit is the operating area, where SMS Siemag offers several advantages compared to conventional solutions. The control desk is the heart of the workplace. Here, the operator receives detailed information on the production process. The HMI screens are located directly in the operator’s line of vision. Additional overview screens are mounted on the ceiling. The desk can be moved by a motor to standing level. The HMI screens move along with it.

Operating elements that are not allowed to be implemented via touch panels or the HMI for reasons of safety are arranged in a clearly structured, accessible manner in the area in front of the screens. In this way, it is ensured that the right measures are taken intuitively – even in emergency situations. Based on new, innovative IT devices, SMS group has developed the Technical Operation Management – TOM for short. This enables the operator to record notes and peculiarities on the production process without paper. The touchpad provided for this purpose is operated intuitively and facilitates quick entries by means of prepared texts and icons. The recorded events are stored in a database and can be further processed later. Large overview screens continuously display the relevant information from the production process. Plant areas that are not easily visible are represented as live images and can be displayed...
in a correspondingly large format whenever required. The operating area is completed by ergonomically optimized control-room chairs designed for 24/7 use, reducing physical strain on the operators and supporting their power of concentration.

THE SOCIAL OR ANALYSIS AREA

With its large number of cabinets and lockers, the newly designed social area provides sufficient storage space. This increases the attractiveness of the entire control pulpit. Located at the center of the control pulpit's social/analysis area is the Data Analysis and Vision Desk – DAVID for short. It has been consciously designed to stand out from the other functional furniture, as a stand-alone item intended especially for teamwork. Equipped with the latest communication technologies, the discussion desk “DAVID” is the information center of the plant. Here, all information for production analyses, performance evaluations and shift meetings is compiled.

To effectively support the teamwork, a large multi-touch display is horizontally installed into the desktop and can be operated intuitively. DAVID and TOM have most recently been purchased by Wuppermann and will be used in the new heat-to-coat hot-strip galvanizing line. “Also our employees will benefit from the new production plant due to its high degree of automation and the ergonomically designed work places,” says Dr. Carl Ludwig Theodor Wuppermann, Spokesman of the Board of Management of Wuppermann.

Also for customer visits, the discussion desk with its wide variety of possibilities will become the focal point and thus be predestined to serve as a central meeting place in the plant. Thanks to the concept operators always have a clear view of the production process.
INDUSTRY 4.0 – UNIVERSAL PRODUCTION MODELS FOR STRIP PROCESSING LINES

SMART PRODUCTION

Industry 4.0 is a collective term for the digitalization of the manufacturing industry. It facilitates the vision of smart production-based intelligent networking of the different automation levels and process models. This means that physical process and production models monitor and control all production processes and parameters. It includes a totally integrated automation system extending from field and control level (Levels 1 & 2) via operation and manufacturing systems (Level 3) up to resource planning and management level (Level 4).

SMS group has been using intelligent automation models for strip processing lines for a long time. It started with mathematical and process models for optimizing single processes in order to save resources and also increase yield and product quality. Furthermore, physical models were developed to predict process results precisely. In this way high product qualities could be ensured and process limits evaluated. The growing number of models and the increasing automation of the lines led to a combination of all available systems. Besides the processes themselves, the production planning became a major matter of interest. The transition behavior between different coils and intelligent planning of the coil sequence are crucial aspects for efficient production. Thus, in a similar manner for all production models in the processing lines, all parameters relevant for processes and production are considered in order to find out the best coil sequence and process parameters.

I-Furnace for cold strip processing – precise and efficient heating and cooling processes are guaranteed by a new mathematical/physical furnace model as well as an annealing microstructure model in combination with the non-contact IMPOC® online measuring system for material strength.
In a typical electrolytic tinning line, more than 200 measuring units provide data for the entire line including closed-loop layer-thickness control which is essential for fast start-up, production efficiency and product quality.

**EXAMPLES**

of process and production models which are integrated into strip processing lines. All models are integrated into the automation system and coupled with other models.

- Eco-pickling model for turbulence pickling lines
- Combined furnace and pickling model for stainless steel
- I-Furnace for cold strip processing
- I-Furnace process and production model for aluminum heat treatment
- Physical process model for tension leveling
- Closed-loop layer-thickness control for electrolytic tinning
- Closed-loop thickness control for color coating lines
- Line Drive Control
- Technological controls for inline skin pass mills

**ECO-Pickling Model**

Consideration of all production related parameters to optimize yield and resource consumption with the ECO-Pickling Model.
EFFICIENCY INCREASE WITH “SPECIAL PROCESSING MACHINES”

The market requirements which strip processing lines have to deal with have altered significantly within the last few decades. In particular, the production has to be economical and ecologically efficient and processing lines have to cover a broad product portfolio. Already existing plants are competing either directly or indirectly with new plants, which are equipped with the latest technologies.

The "Special Processing Machines" are designed to be integrated into existing plants easily and within small downtime phases. All single machines can be delivered in a short time “ready-to-perform” with a tested automation system. Thus, the competitiveness of existing lines can be increased immediately with less effort. To find out which machines can be appropriately implemented, SMS group offers an “Efficiency Check”. A special procedure is used which helps experts to find out quickly which machines will have the largest effect on the efficiency of the plant while at the same time creating the smallest expense.

One example for a “Special Processing Machine” is the ASC side trimmer. In many lines the side trimmer is a bottleneck as regards material strength or reliability. Some lines do not have a side trimmer and cannot satisfy some customer demands. The ACS...
side trimmer is available with a reliable and proven automation kit with a pre-adjusted and pre-installed cutting parameter set-up.

The implementation of new cross-cutting shears in the entry or exit section can have several advantages. For example, an increase in the material strength and the processing speed in this area or a decrease in downtimes due to old, error-prone machines. SMS offers several types of well-proven cross-cutting shears for all areas of application. In the same way, the implementation of a new intelligent flattener in the entry section helps to optimize the efficiency of a plant. More products can be fed safely into the line and be prepared for processing.

Another option is the X-Pro® Laser Welder. With the welder, the product spectrum can be increased up to high-carbon steel grades, which are difficult to weld, and the seam can be fully processed in the line. Furthermore, the downtime in the entry section can be reduced and the availability of the line can be increased.

Regarding hot-dip galvanizing lines, the implementation of a strip stabilization system or a new air-knife are a reasonable way of improving surface quality and yield of the plant as well as reducing zinc and gas consumption.
ALL NECESSARY SERVICES AVAILABLE

In order to fulfill the growing expectations of the various industries served over the long term, steelmakers and aluminum makers must have wide-ranging know-how in terms of the plant technology, operation, processes, quality assurance and, last but not least, qualification and approval procedures. Therefore, comprehensive manufacturing knowledge is mandatory, along with related documentation that must be finally delivered to the manufacturers.

In cooperation with MET/Con, SMS group offers process support for all materials and grades. This covers both metallurgical and design activities as well as support during commissioning, operation, quality control, qualification and approval. The experts involved look back on long production experience and offer full parameter sets for all processing steps. This ensures a safe production also of difficult and high-quality grades. Furthermore, minimization of operational costs becomes possible, for example through minimized resource consumption or the use of alloying elements.

Consistent, well-documented quality and production planning and control is essential to fulfill the requirements of the end users of advanced steel grades.
KNOW-HOW AND TECHNOLOGY PACKAGES

- Process capabilities and organization evaluation
- Steel grade focussed or continuous production assistance and process optimization
  - Mechanical or electrical properties
  - Surface
  - New steels
- Hands-on training
- Quality control (planning, testing, defect analysis with countermeasures)
- Grade books (process and operation parameters of complete production route)
- Certification and approval assistance

PROJECT ASSISTANCE

- Market analysis
- Feasibility studies
- Project development and assessment
- Tender support
- Provision of medium and long-term operators

Process parameters of the different production steps, starting in the melt shop and continuing down to the final production step, have to be adjusted to each other in order to produce high-quality end-materials and to pass qualification procedures.
ECONOMIC AND ECOLOGICAL TURBULENCE PICKLING LINES

ECO-FRIENDLY DESCALING AT HIGH CAPACITIES

SMS group delivers pickling lines from a single source as a system supplier. The lines are outstanding for their high pickling performance as well as low maintenance and operating costs over a long service life. With the ECO production and pickling model and various other innovations, it has become possible to increase the performance still further.

The turbulence pickling process can be integrated into all lines designed for pickling carbon steel: pickling line/tandem cold mills, continuous, semi-continuous, and push-pull pickling lines.

There are, however, more advanced components for carbon steel pickling lines from SMS group. Just one example is the X-Pro® laser welder that joins even hard-to-weld materials. The mechanical equipment...
used here, such as scale breakers, loopers, entry and exit sections, is specifically tailored to the conditions in pickling lines. Our cold rolling mills come in a modular design, complete with high-tech elements such as CVC® plus technology. Effective and eco-friendly, acid regeneration plants recover spent pickling acid and feed it back into the process. This means SMS group is your one-stop-shop for complete pickling lines, including coil logistics, binding, strip treatment, laser welding machines, all the mechanical components, and drive and control technology. This ensures that you can cut your operating expenses for your overall plant because both your maintenance and spare parts costs are minimized due to perfectly matched components. You also save on customer coordination and training costs.

Pickled and cold-rolled coils for the market or further processing in galvanizing or annealing lines.

Pickling sections consist of three to four pickling tanks with own circulation systems.
LINE TYPES

Off-the-peg is not our style. SMS Siemag tailors your pickling line to your specific requirements. Depending on the capacity, the steel grades and qualities as well as the strip dimensions you want to produce, your plant comes equipped with the right technologies and components. Generally speaking, pickling lines are available in four types.

Push-pull pickling lines (PPPL)
This is where strips are threaded into the pickling line individually and pushed or pulled through the process section. The advantages of this discontinuous production method are its great flexibility in terms of production planning and materials that can be processed as well as easy manufacturing of thick strip.

Semi-continuous pickling lines (S-CPL)
Outstanding features of semi-continuous pickling lines are the small loopers that ensure that the strip in the process section does not have to come to a complete stop while the strips are being joined by a stitcher in the entry area. As a result, it is not necessary to re-thread every length of strip. These plants are suitable for small to medium capacities. An added advantage is that they can be subsequently upgraded to continuous models.

Continuous pickling lines (CPL)
A welding machine at the entry of the continuous pickling line joins individual strips into endless strip, then horizontal loopers ensure continuously high speed in the processing section. That means you achieve top quality standards at very high capacities. Continuous pickling lines can also be coupled to cold rolling mills.

Pickling line/tandem cold mills (PLTCM)
What happens here is that these mills continuously pickle and cold-roll hot-strip in one go. They come with three loopers to ensure a continuous process. Both the entry and exit areas are designed so that the plant can operate continuously at high speed.
Typical plant parameters:

<table>
<thead>
<tr>
<th>Strip thickness</th>
<th>Strip width</th>
<th>Capacity</th>
</tr>
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<tbody>
<tr>
<td>1.2 – 6.5 mm</td>
<td>600 – 2,080 mm</td>
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Typical plant parameters:

<table>
<thead>
<tr>
<th>Strip thickness</th>
<th>Strip width</th>
<th>Capacity</th>
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<tr>
<td>1.2 – 6.5 mm</td>
<td>600 – 2,080 mm</td>
<td>1,500,000 – 2,500,000 t/a</td>
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Typical plant parameters:

<table>
<thead>
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<th>Strip thickness</th>
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<tr>
<td>Entry: 1.2 – 6.5 mm</td>
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<tr>
<td>Exit: 0.3 – 3.5 mm</td>
</tr>
<tr>
<td>Strip width: 600 – 2,080 mm</td>
</tr>
<tr>
<td>Capacity: 1,500,000 – 2,500,000 t/a</td>
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</tbody>
</table>
ECONOMIC AND ECOLOGICAL TURBULENCE PICKLING LINES

TURBULENCE PICKLING TECHNOLOGY

Racks of nozzles are constantly spraying heated hydrochloric acid into the shallow pickling channel and generate an extremely high turbulence. This ensures maximum contact between the acid and the strip surface by continually forcing fresh acid into the cracks in the scale layer. It only takes a short time to create the required electrochemical potential which results in fast and efficient pickling. The patented immersion cover above the pickling channel closes off the acid bath surface, minimizing evaporation losses by 30% and the heat losses by 70%. Furthermore, the exhaust system requires a smaller volume, which again reduces losses.

SPRAY-BOOST-CELLS

With the innovatory "Spray-Boost Cells", a very high pickling capacity can be achieved over a short distance. Especially for modernizations during which the pickling capacity is to be increased with only limited space available, this system is an efficient solution. Here, the acid is sprayed onto the strip at high pressure, thus achieving a high pickling capacity. The patented spray headers ensure homogeneous distribution of the acid across the entire strip width. Furthermore, the desired pickling capacity can be flexibly adapted here via the process parameters.
ECO PRODUCTION AND PICKLING MODEL

All the key pickling process parameters are actively controlled and perfectly adjusted to the requirements of each hot strip coil. Simultaneously with the coil sequence, the model optimizes and controls the transition process between different coils to achieve optimum pickling results at low energy consumption. The model generates several operational savings. Due to a reduction of overpickling, it is possible to increase the annual output. Furthermore, a lot of acid and steam can be saved.

RECUPERATOR TANK

In the patented recuperator tank upstream of the first pickling tank, the hot waste acid is sprayed directly onto the strip. This removes loose scale particles, heats the strip and chemically activates its surface to speed up the subsequent pickling process. Thus, not only the pickling results will be optimized and thermal energy saved, but it also cuts down acid consumption due to pre-pickling and -activation.

The hot waste acid is used to pre-clean and pre-activate the strip surface in order to increase the efficiency of the pickling process.
ECONOMIC AND ECOLOGICAL TURBULENCE PICKLING LINES

ACID REGENERATION PLANTS

An increasingly important factor for any pickling plant is compliance with environmental protection regulations, plus high energy efficiency. Acid regeneration plants for hydrochloric acid are an outstanding example of green and efficient technology. Depending on the individual customer requirements, spray roaster or fluidized bed technology is used. These systems put the regenerated acid back into the process and produce a valuable by-product. Thus, all resources are circulating in a closed-cycle inside the plant. Even considering only the saved transportation costs for waste acid and rinse water, which do not have to be neutralized, savings of more than EUR 250,000 per year are possible for a conventional pickling line.

INTEGRATED SUCTION CONCEPT FOR SCALE DUST

An integrated central suction system with several suction devices minimizes scale dust problems in the entry area of pickling plants, while simultaneously reducing the suction power. This makes pickling lines safer, more effective and greener. In practice the advantages are better working conditions for the employees, reduced wear, no sudden downtimes due to contaminated components and minimized dust emissions. The manual cleaning requirements are reduced to a minimum.
**X-PRO® LASER WELDER**

An advantage of the welder is the continuous production (inclusive of cold rolling) of difficult-to-weld steel grades. At the Hysco PL/TCM, martensitic steel grades (MS-W1200) were successfully welded to each other and rolled with high reduction. Furthermore, steels with a silicon content of 1.2% were also welded successfully; much higher Si-contents are also possible. Other advantages are the short machine cycle time of less than 60 seconds and simplified operation with reproducible results.

The compact welding machine comes with numerous innovative features, e.g.:
- Automatic adjustment of the welding parameters to new material pairings
- Patented inductive heat treatment of the weld seam (pre- and post-heating)
- Integrated and automatic weld seam analysis system inserted in a closed loop.

In addition, the welding source can be freely selected, providing the opportunity to use a conventional CO₂ source or a solid-state laser source. With a solid-state laser it is possible to save process gas (e.g. helium) and reduce the maintenance effort.
PICKLING LINE / TANDEM MILL FOR JSW, INDIA

The new combined pickling line/tandem cold mill at JSW Steel Ltd. is highly regarded thanks to its environmentally friendly components, low maintenance costs and high quality.

The pickling line/tandem cold mill in CVC® plus six-high design has been in operation in Toranagallu, in the state of Karnataka, India, since October 2013. JSW now has a yearly production capacity of 2.3 million tons of cold strip with maximum strip widths of 1,890 millimeters and minimum end gages of 0.3 millimeters. The strips are mainly intended for use in the automotive industry and, amongst others, are made of high grade and multi-phase steels.

In the entry section, the strips are joined by an X-Pro® laser welder, which also joins difficult-to-weld steel grades without filler metal. A newly developed, integrated suction system reduces exposure to scale dust. In the turbulence tank pickling section, a tension leveler then breaks up the scale, and loose scale particles are removed from the strip in a recuperator tank, while the strip is preheated and chemically activated. In the three pickling tanks, each 35 meters long, the strip is efficiently descaled.
SMS delivered all strip processing lines for the cold rolling complex at AM/NS Calvert (formerly ThyssenKrupp Steel USA) in Alabama, USA. A pickling line/tandem cold mill and a continuous pickling line, which have both successfully been in operation since 2010, are part of the complex, in addition to four cold strip processing lines.

The pickling line/tandem cold mill has a yearly capacity of 2.5 million tons. The up to 1,870 millimeter wide strips are pickled in three turbulence pickling tanks, each 35 meters long, then reduced on the coupled five-stand four-high tandem cold mill to final gages of 0.3 to 3 mm.

The continuous pickling line is designed for a capacity of 1.1 million tons per year. And the current layout allows for a capacity expansion to 1.6 million. In the entry section, the strips ends are joined by an X-Pro® laser welder to form an endless strip with a thickness between 1.5 and 6.0 millimeters. In the next stage of the process, the strips are treated in the turbulence pickling section with a maximum pickling rate of 110 m/min.

In total, well over 3 million tons of steel strips can be pickled per year in the two pickling lines.

Upon entry to the continuous pickling line, an X-Pro® laser welder reliably joins the hot-strip ends to form an endless strip.
In August 2014, Gazi Metal’s new semi-continuous pickling line produced its first strip in Turkey. The pickling line represents a key element in Gazi Metal’s new production complex in Karasu. SMS group delivered all the essential production facilities, including mechanical systems, process technology, and the electrical and automation systems.

The pickling line frees the hot strip from scale and prepares it for the rolling process that follows. Gazi metal decided on a semi-continuous pickling line for a plant concept with a capacity of 350,000 tons per year, that can easily be converted into a continuous pickling line with double the capacity. Two small horizontal strip accumulators, which ensure a minimum process speed, are a major feature of this concept. The process section consists of a tension leveler and a 54 meter long turbulence pickling section. Next, the strip passes through a trimming shear and a DUMA-BANDZINK oiler. In order to further re-condition the used and iron-fortified hydrochloric acid from the pickling process, a fluidized-bed acid regeneration plant with a capacity of 1,700 liters per hour is used.
In November 2011 the new push-pull pickling line at Steel Dynamics Incorporated (formerly Sever-Corr) in Columbus, Mississippi, USA, successfully produced its first coil. Hot strip up to 1,880 mm wide can be uncoiled, leveled, pickled, side-trimmed and wound back into coils on the line.

The strips, of gage up to 12.7 mm, are conveyed discontinuously through the line at a speed of up to 152 m/min. The range of materials handled comprises mild deep-drawing grades, IF and state-of-the-art high-strength steels. The annual capacity attainable with this range of materials is around 540,000 t.

The quick-to-erect plastic tanks are provided in flat turbulence-tank design. They are protected from wear on the inside by blocks of granite. Furthermore, both thin and mild, as well as thick and hard steel strips are safely threaded and firmly guided by the V-shaped granite profile. The strong turbulences in the narrow pickling channel reinforce the pickling process, shorten the pickling time and save energy.

The push-pull pickling line at SDI ensures a high, scale-free surface quality and is characterized by its high economic efficiency and flexibility.
The galvanizing of hot strip enables the production of zinc-coated steel strips with long-life corrosion protection and an attractive look, at low production and investment costs. There is a growing market and a great many areas of application for galvanized hot strip, for example in the construction, furniture or automotive industries.

Economically-speaking, the use of galvanized hot strip is particularly attractive for applications where a galvanized cold strip would normally be used. Because a number of cost-intensive process steps are omitted from the production of galvanized hot strip compared to the production of galvanized cold strip, enormous cost advantages arise here, which ultimately increase the margins of the steel producer. The classic way to galvanize hot strip consists of heating the already pickled hot strip to galvanizing temperature on a line and then galvanizing and post-treating it. Economically-speaking, the production of galvanized hot strip in combined pickling and galvanizing lines, just like those established by SMS, is considerably more effective. Here, galvanized hot strip is first pickled on a line, heated to galvanizing temperature, galvanized, skin-passed and post-treated (“heat-to-coat” process).

Thus, a high-value end product, that can be delivered to many customers, is made from unpickled hot strip in one step. In order to increase the material quality – particularly the flexibility – of first and foremost very thin materials, further modifications to the line concept are possible, depending on the hot strip used. Particularly suitable options are the integration of a skinpass mill stand and an annealing module.
In 2014 the Wupperman group commissioned the SMS group to deliver a hot-wide-strip pickling and hot-dip galvanizing line for the new works in Győr-Gönyű, Hungary. SMS is delivering the complete line, including the mechanical equipment, process engineering, and electrical and automation systems. "We have been working together with SMS for decades and are delighted to continue this cooperation", said Dr. Carl Ludwig Theodor Wuppermann, Chief Financial Officer and Spokesman of the Board of Management at Wuppermann, during the signing of the contract in Leverkusen, Germany. SMS has already been successful in developing and putting Wuppermann’s first hot-wide-strip pickling and hot-dip galvanizing line into operation in Moerdijk, the Netherlands. The new strip processing line will go into operation in 2016 and will process approx. 500,000 tons of steel per year. The strip widths will range from 400 to 1,650 millimeters and the strip thicknesses from 1.0 to 6.0 millimeters.

In the "heat-to-coat" hot strip galvanizing line, scale-covered hot strip is pickled, galvanized, and post-treated in an economically efficient process, so that a high-grade end product with a wide scope of applications is produced.
ANNEALING LINES AND GALVANIZING LINES FOR COLD STRIP

SYSTEM SUPPLIER FOR ANNEALING LINES AND GALVANIZING LINES

Annealing lines and galvanizing lines from the SMS group are characterized in particular by the excellent quality of the end product, high efficiency and economy, as well as enormous capacities. In recent years various improvements and new technical solutions have been developed, particularly regarding line concepts, furnace technology, galvanizing technology and post-treatment.

It has been proven that SMS has the competence to design, engineer, erect and put into operation modern cold strip processing lines. Supported by the various specialized companies within the SMS group, which offer equipment and services for annealing lines and galvanizing lines (DREVER, DUMA, BAND-ZINK, Elotherm, EMG, FOEN, IAS, MET/Con), the lines are delivered from a single system supplier.

High and well-documented quality of the end product is crucial for the economic success of a cold-strip processing line.
PRODUCTION OF AUTOMOTIVE GRADES

Steel continues to be the most important construction material for the automotive industry, whereby particularly the share of high-strength steels in cut-throat competition with other materials is constantly increasing. As manufacturers are required to build light and fuel-efficient vehicles, many new steel grades with optimized combinations of properties have been developed. Multi-phase steels, which are high-strength and very ductile, are increasingly being used for car components. These high-strength yet easily deformable steels must meet the highest quality requirements for use in automobiles, whereby not only the material properties, but also the surface quality must be of a high standard.

Hence, strip processing lines for the production of high-quality steel plates for use in interior and exterior components (usually hot-dip galvanizing lines and annealing lines) must be set up to produce high material strengths and flawless surfaces. In the lines, account is taken of the stringent demands on surface quality. This commences with cleaning, which is followed by surface-friendly annealing, and high-grade coating technologies for the application of a zinc layer, passivation or preserving oils. Advanced annealing and cooling strategies are implemented, together with a skin-pass millstand for targeted post-treatment, in order to achieve outstanding material strengths.

In automotive construction, a growing number of steels with higher strength and good forming properties are being used.
**FURNACE TECHNOLOGY**

**RAPID COOLING WITH GAS**

The DREVER Ultra Fast Cooling System cools while perfectly preserving the strip shape by hydrogen injection. It achieves cooling rates of up to 150 kelvin per second and millimeter of strip thickness. Even more convincing is the fact that this system requires no extra hydrogen, which makes it ideal for high-strength multiphase and TRIP steel grades with strengths of up to 1,000 megapascals. Furthermore, all this is possible with a reduced amount of expensive alloying elements.

**PRE-OXIDATION CHAMBER**

During the heat-up process for high-alloyed steel grades in the galvanizing furnace, manganese and silicon oxides appear on the surface of the strip. The oxides have very low wettability, causing quality problems during the hot-dip galvanizing process. With the pre-oxidation technology the dew point is altered in the pre-oxidation chamber. This effect causes the strip surface – including the areas of the manganese and silicon oxides – to be covered by an iron layer which has the required wettability.

**INTENSIVE COOLING WITH WATER**

Alternatively, our Water Spray rapid cooling system involves immersing the strip in demineralized water while special nozzles spray it from both sides at high pressure. Here, the cooling rate is more than 1,000 kelvin per second and millimeter of strip thickness, enough for manufacturing tough dual and complex-phase grades and martensitic grades with tensile strengths of 1,500 megapascals and more.
ANNEALING CURVES

This comparison of typical annealing curves for different high-strength steels shows that production plants must offer considerable flexibility with regard to heat treatment. Using these various cooling systems, SMS-lines produce the latest high-strength steel grades for the automotive industry. That allows for lighter, fuel-saving vehicles.

I-FURNACE

During heat treatment, microstructure is precisely adjusted to meet requirements regarding strength and formability. Precise and efficient heating and cooling processes are guaranteed by a new mathematical/physical furnace model and an annealing microstructure model. In combination with the non-contact IMPOC® online measuring system for tensile and yield strength, this is a great step forward towards an autonomous working furnace. Special sophisticated grades can be produced more easily and homogenous material characteristics over the whole coil length can be achieved. A capacity increase up to 15 percent is possible due to better utilization of the furnace capacity as well as efficient production planning and transition behavior. Also energy savings can be realized due to better temperature control close to its lower limit (on average -10 K).
HIGH MATERIAL AND SURFACE QUALITY

ULTIMATE SURFACE QUALITY

The stand-out feature of SMS hot-dip galvanizing lines is that they are capable of producing best surfaces (C-surface). This is a fundamental requirement because only materials of this quality can be used for automotive outer skins.

STRENGTH MEASUREMENT

The IMPOC® measuring system from EMG – integrated in hot-dip galvanizing and annealing lines – continually checks the material’s tensile strength as well as yield strength during production. That allows the operator to immediately adjust process parameters whenever necessary. Non-destructive magnetic measurement shows that homogeneous material properties are achieved even at high tensile strengths. Today there is a growing number of automotive manufacturers who use this system for checking materials.

COATING PRECISION

A key quality characteristic of our hot-dip galvanizing lines is the accuracy of the coating thickness. Complying with narrow coating tolerances means you also save zinc and cut production costs. What mainly determines excellent coating precision is the efficient air knife system. Also significant here is zinc pot equipment tailored to the special requirements of the process as well as a strip stabilizing system that guarantees smooth strip travel and superb coating precision.
LINE TYPES – ANNEALING LINES AND GALVANIZING LINES

AUTOMOTIVE-LINES

The annealing lines and the hot-dip galvanizing lines are the most important cold strip processing lines for the production of automotive grades, whereby both high-level exposed surface quality and high-strength materials are required.

Typical technical data

<table>
<thead>
<tr>
<th></th>
<th>Galvanizing</th>
<th>Annealing</th>
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<tr>
<td>Strip width</td>
<td>750 to 2,080 mm</td>
<td>700 to 2,150 mm</td>
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<tr>
<td>Strip thickness</td>
<td>0.25 to 3.0 mm</td>
<td>0.25 to 3.0 mm</td>
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<tr>
<td>Process speed</td>
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<td>Capacity</td>
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</table>

HORIZONTAL GALVANIZING LINES

In addition to the lines which are designed mainly for automotive quality, SMS also offers some simpler line concepts, which are intended mainly for the production of materials for the construction, household appliances or furniture industries. These lines can also be used in part to produce materials for automotive applications.
Batch annealing furnaces serve to anneal and cool cold strip coils in the batch mode. They are able to process several coils simultaneously.
MULTI-PURPOSE LINES

FLEXIBILITY AND COST-EFFECTIVENESS

More than ever, cost-effectiveness and flexibility are the main demands manufacturers make on strip processing lines. These two aspects are profoundly interdependent in a constantly changing market environment. Flexible production conditions the greatest possible efficiency in reacting to changing demands with. This is where automotive lines from the SMS group stand out because of their extreme flexibility thanks to the highly developed, tried-and-tested technologies and components that are applied. Integrated in the radiant-tube furnace from DREVER are

UNIVERSAL ANNEALING LINE WITH RAPID COOLING AND WATER-SPRAY COOLING

Apart from an ultra-fast cooling zone with cooling rates of up to 150 kelvin per second and millimeter of strip thickness, this type of line comes optionally with a water-spray cooling system that achieves cooling rates in excess of 1,000 kelvin per second and millimeter. This makes it suitable not only for the high-strength grades that require rapid cooling, but also for martensitic and dual-phase steels with tensile strengths of 1,550 megapascals and more.

UNIVERSAL ANNEALING AND HOT-DIP GALVANIZING LINE

Here is a special type of line in which the cold strip first goes through recrystallization annealing, then moves on to either a zinc bath or an overaging zone. You benefit from a flexible line that produces two different product groups (annealed and galvanized) in extremely high quality.

ALL-PURPOSE LINE

To create maximum versatility, this line type features four different process routes. Following slow cooling, the steel strip can run through one or more of these routes. The line comes with two cooling systems (ultra-fast cooling and water-spray cooling) as well as a galvanization option. Furthermore, annealed materials can be re-heated in an overaging or tempering zone.

– Annealing line rapid cooling mode
– Annealing line water-spray cooling mode
– Hot-dip galvanizing line mode
– Annealing line rapid cooling mode
– Hot-dip galvanizing line water-spray cooling mode
– Annealing line rapid cooling mode
– Annealing line water-spray cooling mode
adjustable annealing curves, high cooling rates, and special surface preparation technologies. It meets all the requirements for annealing and subsequently coating a large range of products, including modern high-strength steel grades. Systems for changing the zinc pot as well as state-of-the-art air knives provide the option of different strip coatings.

SMS group can do even more for you – for instance in the field of post-treatment: with flexible components for setting a whole range of product properties. Universal cold strip lines that offer different processes for the strip, depending on current requirements, provide even more flexibility.
REFERENCES

MAGNITOGORSK IRON AND STEEL WORKS, RUSSIA
Hot-dip galvanizing line and universal annealing and hot-dip galvanizing line

The two cold strip lines in the MMK plant in Magnitogorsk, Russia, together produce more than one million tons of high-quality steel strip, especially for automotive outer and interior parts. This is where SMS erected a pure hot-dip galvanizing line and a universal annealing and hot-dip galvanizing line for MMK. It is a plant array that covers a very wide range of top-quality materials – from mild to high-strength grades – and produces two different product groups (annealed and galvanized) as required. Everything for the lines was supplied from one source: mechanical equipment and hydraulics, furnace technology and air knives, and post-treatment.

Furthermore, SMS was responsible for the entire electrical and automation systems complete with Plug-and-Work integration tests. Both plants went on stream in summer 2012. As early as the end of November, MMK issued the final approval for the lines after an effective start-up phase.
HANDAN IRON & STEEL, CHINA
Continuous annealing line with record capacity

Engineered for an annual capacity of over one million tons, the annealing line at Handan is one of China’s largest plants of this type. SMS was awarded the order for the almost 500-meter line in August 2008, and commissioning in September 2010 was two and a half months ahead of schedule.

To achieve this impressive capacity, the line is operated at a speed of up to 450 meters per minute and the maximum strip width is 2,080 millimeters. A special feature is the annealing furnace from DREVER, directly connected to an ultra-fast cooling zone. This cools the strip extremely rapidly yet evenly, while retaining the strip shape and producing very good surfaces.

The integrated six-high skinpassing mill achieves a skinpassing degree of up to 3 percent and features rolling technologies such as CVC® intermediate roll shifting and work roll and intermediate roll bending. This is where the strip gains its required surface and flatness properties.
REFERENCES

AM/NS CALVERT, USA
Three automotive lines

Included in the supply scope of SMS for the AM/NS Calvert plant in Alabama (former ThyssenKrupp Steel USA) were two hot-dip galvanizing lines and one continuous annealing line for high-strength and high-ductility automotive grades. A further hot-dip galvanizing line produces materials for the household appliances and construction industries. There is similar equipment available in these two automotive hot-dip galvanizing lines that produce galvanized or galvannealed material for exterior and interior vehicle parts. Both lines feature a DREVER radiant-tube furnace and FOEN air knives. One of the lines is also equipped with a FOEN DEMCO® strip stabilization system.

The annual production capacity of each line is some 500,000 tons. It is equally possible to produce an additional 700,000 tons of annealed steel strip per year on this annealing line, also destined for the automotive industry. Just as innovative is a design that allows our customer to upgrade this line to a universal annealing and hot-dip galvanizing line at any time. The lines went into production as from April 2011.
The first time Hyundai Hysco contracted SMS to erect a universal annealing and hot-dip galvanizing line was in 2005. It was a complex project, involving installation of the necessary components for hot-dip galvanizing in an existing annealing line and the construction of bypasses so that the line could be re-commissioned as an annealing and hot-dip galvanizing line in 2006.

Then, in 2012, Hyundai Hysco again decided on a very versatile plant solution and ordered another universal annealing and hot-dip galvanizing line as well as a pure hot-dip galvanizing line from SMS for its cold rolling complex in Dangjin, South Korea. Both lines successfully went into production in April 2013 and have since then been producing high-strength steels for Korean automotive manufacturers.

SMS supplied most of the mechanical and process-engineering equipment, including DREVER furnaces and FOEN air knives.

As early as May 2013, the plant produced 33,000 t of cold strip including deep-drawing and high-strength grades.

The steel strip is supplied to customers including Hyundai Motors and KIA Motors.
Acting as a consortium leader, SMS group built two continuous annealing lines for Shougang Jingtang on the man-made Caofeidian Island in north-east China. The first line was ordered as recently as 2007 and started production at the end of 2009. Then the second line, ordered in 2008, went on-stream five months ahead of schedule in December 2010. Together, the plants are designed to process almost two million tons of cold strip per year from the pickling line/tandem cold mill also supplied by SMS, with most of this material going to the automotive industry. Both lines achieved a successful production start with an excellent start-up curve.

Shougang Jingtang is a joint venture between Shougang and Tangshan, which rank among China’s largest steel producers. It was partly due to the good cooperation between us that the joint venture contracted SMS Siemag in 2011 to erect a tinplate annealing line and two electrolytic tin-plating lines in the plant.

The Shougang Jingtang plant can anneal some two million t of automotive cold strip per year.
Since 2013, the annealing line at PRO-TEC in Ohio, USA, has been producing high-strength and ultra-high-strength steel strip used to make interior components for cars, SUVs, and trucks. Included here is a DREVER annealing furnace with two cooling systems.

What is special about this modular design is that it offers two alternatives downstream of slow cooling: the ultra-fast cooling system with a cooling rate of up to 120 kelvin per second and millimeter of strip thickness, and the water-spray cooling system with a cooling performance of more than 1,000 kelvin per second and millimeter of strip thickness. Water-spray cooling is necessary to produce grades such as martensitic and ultra-high-strength qualities with a tensile strength of over 1,500 megapascals. These steels are mainly used for manufacturing crash-resistant major components in the passenger cell.

It is possible in some cases to save up to 40 percent of the weight. Besides being responsible for the design and engineering of the mechanical equipment, SMS group also supplied the entire electrical and automation systems.

The commissioning team celebrates the first high-standard coil.

The line produces some 500,000 t of high-strength steel strip per year.
COLOR COATING LINES FOR CARBON STEEL

Organically coated plate is now standard in the customer world and is being used increasingly wherever aesthetics are required in addition to corrosion resistance. Aside from the construction industry, the biggest buyers of coated plates are household and electrical appliance manufacturers. But ready-coated plates are being used increasingly frequently in the automotive industry. Contrary to coating individual pieces, the continuous coating of steel strips – coil coating – creates considerably more economical products. The plates can be reshaped into products by customers without having to repaint them.

Depending on the requirements regarding corrosion protection, formability, temperature stability, desired color, degree of gloss and surface hardness, a cold rolled or galvanized thin sheet with various layers is provided, whereby very different configurations and designs of the coater are used. In the paint coating lines, different coaters are generally used for the conversion coating, the base coat and the varnish.

All coaters are controlled so that the fluid media are applied evenly and in the desired thickness. Furthermore, the color coating lines are characterized by an environmentally friendly catenary or floatation oven for hardening the paint coat, to which an RTO plant (Regenerative Thermal Oxidation) is connected. Thus, the energy from the drying of the evaporated solvent is transferred back into the process.

A regenerative incineration system (here with three chambers) burns the solvent-containing air and regains the energy produced.
Two Color Coating Lines for Severstal

Severstal’s new color coating line in Cherepovets, Russia, was successfully put into operation at the end of 2011 and production quickly increased in the following months. After only a few weeks, salable material was already being produced by the plant, which was delivered by SMS. The new plant is of identical design to the SMS color coating line that went into operation at Severstal at the end of 2005. Besides the very high process speed, the highlights of the line are the roll coaters and the high-performance drying ovens. In the future, a further 200,000 tons per year of hot-dip or electrolytically galvanized cold strip will be color coated in western Russia. The strips are mainly used in the construction and household appliances industries. In the plant, the strip surface is cleansed by spray and brush degreasing in a cleaning section. A vertical roll coater applies a conversion coating to the prepared surface, which is then dried. Then the strip is prime-coated in a back-up roll coater and passes through a low-emission catenary hardening oven. The strip can then be coated with a finish coat in two back-up roll coaters and hardened in another curing oven. All the coaters have high-precision control for the precise and consistent application of media. In addition, the strips can be provided with a protective film in the exit section.
The SMS group offers innovative, technical solutions at all steps of tinplate production for the efficient processing of cold strip into packing material. All the necessary treatment facilities can be delivered from a single source, including mechanical and processing equipment, furnace technology, electrical and automation systems and production know-how. The electrolytic tinning lines are fitted with soluble anodes, which create significant economic, ecological and process-engineering advantages.

Generally there are two different process routes for the production of tinplate. In the conventional route the cold-rolled strips are cleaned in an electrolytic cleaning unit, moved to a batch annealing furnace for recrystallization annealing and then surface-treated and reduced in an offline skin-pass mill stand. In the other route—which is often used for higher capacities - all the process steps take place in a continuous tinplate annealing line with an inline skin-pass mill stand. Finally the material is coated with tin on an electrolytic tinning line.
**TINPLATE**

Electrolytically tinned ultra-thin sheet (tinplate) is a cold-rolled, recrystallization-annealed and, in some cases, reduced thin sheet made of carbon steel onto which a firmly adhering tin coating has been applied by an electrolytic process. The tin coating protects the base material against corrosion and, furthermore, acts as an excellent primer for subsequent painting, provided that proper surface-treatment has been carried out. Due to the main application of tinplate being packing material, it is also known as "packaging steel". Tin cans for foodstuffs, pet food and beverages are a main area of application. Packaging for chemical-engineering products and spray cans for aerosols are also made from this thin material. Furthermore, closures such as lids and crown caps are often made from tinplate.

**ELECTROLYTIC TINNING**

In electrolytic tinning, the tin is applied to the strip surface by electrochemical precipitation, in which the strip travels through an acid electrolyte. The electrolyte acts as an ionic conductor because chemical processes occur due to the directed movement of the ions at the electrodes during the transfer of the charge. The thickness of the tin layer can very easily be adjusted via the magnitude of the electric current and via the processing time, which depends directly on the strip speed. Very thin layers of just a few micrometers can thus be applied very precisely. Depending on requirements, differing layer thicknesses can also be applied to the strip sides.
TINPLATE LINE CONCEPT

TINPLATE ANNEALING LINE

The annealing of the cleaned strip followed by reduction and surface treatment provides the material in the annealing line with the material and surface properties necessary for tinning and subsequent processing. The very thin material (up to 0.1mm) is processed on the lines at very high speeds (up to 750 m/min). The product range comprises all grades and also contains the qualities T2.5, T5 and DR 10, which cannot be produced by batch annealing. The strip cleaning section has efficient process components including spray and electrolytic cleaning cells. The radiant tube furnace is the heart of the plant and is recognized for its low resource consumption. Due to precise furnace control, the process follows the specified annealing curve exactly. Two 4-high skinpass mill stands are integrated for post-treatment. The

ELECTROLYTIC TINNING LINE

The significant process steps in an electrolytic tinning line are cleaning, leveling, pickling, tinplating, remelting and passivating. All of these process steps must fulfill high requirements in order to guarantee the surface quality of the end material. SMS offers various innovative technologies for tinning lines, which increase the ecological and economic efficiency of the plant. (see following pages)
The first skinpass mill stand adjusts the mechanical-engineering characteristics of the strip by a thickness reduction. The second creates a defined strip surface structure.
SOLUBLE ANODES

The use of soluble anodes results in significant economic advantages compared to using insoluble anodes. Simply by reducing tin loss caused by sludge formation and paying lower prices for tin, it becomes possible to save up to 2.7 million euros per year. Moreover, there are no costs for dissolving the tin nor reconditioning the anodes. A further benefit are stable tinning conditions, given the parallel anode arrangement with the anode width being adapted to the strip width without the use of edge masking.

CLOSED-LOOP TIN LAYER THICKNESS CONTROL

More than 200 measuring units are installed along the tinning line. In combination with the real-time measurement of the tin layer thickness, the line is operated in the so-called closed-loop mode. This makes it possible to constantly monitor and set all line parameters and to guarantee the best possible product quality and production efficiency. Up to 5% of the tin can be saved by a more precise adjustment of the tin layer thickness.

REFLOW TECHNOLOGY

The induction unit, which can be adjusted vertical to the direction of strip travel, is very important for the surface quality. Due to a 100% induction the heat transport takes place contact-free, consistently and without the formation of "wood grains". Because the induction unit can be moved vertically, the heat-treating time can be correctly adjusted for all process conditions.
**EVAPORATOR**

The contaminated rinsing water generated by tinplating and passivation is split up into a concentrate (electrolyte) and a distillate (rinsing water) in an advanced evaporator system and is reused in the process. Operating expenses are significantly reduced by this closed-circuit material flow. Moreover, the evaporators are heated by vapor compression from the process vapor itself.

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**PRECONDITIONING CELL**

The preconditioning cell is a special process component through which the strip travels right before entering the first tinning cell. Here, the strip is pre-activated and the last iron hydroxide particles are removed. This ensures that the iron content in the electrolyte remains at a stable low level.

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**ANODE CASTING PLANT**

An anode casting plant casts the anodes at a consistent temperature without tin loss. The fully automated casting process produces perfectly shaped, high-purity tin anodes from the anode remnants and tin billets.
TINPLATE PRODUCTION AT SHOUgang Jingtang in China

Tinplate has been produced at the Shougang Jingtang works on Caofedian Island since October 2013. SMS erected a tinplate annealing line with an inline DCR rolling mill, an offline DCR rolling mill, and two electrolytic tinning lines on the artificially created island off the coast of the Chinese province Hebei. A total of almost 500,000 tons of high-grade tinplate can be produced in order to fulfill the growing demand for packaging material in China.

TINPLATE ANNEALING LINE WITH REDUCING/SKINPASS MILL

The tinplate annealing line has a capacity of more than 435,000 tons per year. An outstanding feature of the line is that it can reliably process very thin strips (down to 0.12 mm) under stringent quality demands and at very high speeds (up to 750 meters per minute). A component of the annealing line is an inline DCR mill (Double Cold Reduction), which consists of two 4-high millstands, with CVC® plus and other tried-and-tested technologies, such as work roll bending, multi-zone cooling and DS system. This skin-pass rolling mill combines a thickness reduction of up to 42 percent in the first stand with skin-passing in the second mill stand. The flexible and technologically fully equipped plant can be used either for wet or for dry skinpassing. In the exit section of the line, an electrostatic DUMA-BANDZINK oiler provides the strip with a preserving oil film.

A total of almost 500,000 tons of high-grade tinplate can be produced by the two tinning lines for the manufacturing of packaging material.
OFFLINE REDUCING/SKINPASS MILL

In order to further reduce and skin pass annealed material in a batch process, SMS delivered an offline CVC® plus DCR mill with equivalent technical equipment to that of the inline DCR rolling mill. On this line, not only tinplate but also strip made of standard steel, are re-rolled and skin-passed. The yearly capacity of the offline DCR rolling mill amounts to more than 420,000 tons.

ELECTROLYTIC TINNING LINE

With a total yearly production capacity of 475,000 tons, the two identical electrolytic tinning lines can tinplate all the material from the previously mentioned plants.

In both electrolytic tinning lines, tin is distributed on the strip surface by means of an electro-chemical precipitation process, while the strip moves through an electrolyte in nine vertical tinning cells. Shougang Jingtang decided to use soluble anodes due to the economic advantages offered by them. Furthermore, all the modern equipment for tinning lines that SMS supplies, are integrated in to the line, such as a pre-conditioning cell, an evaporation unit, anode casting equipment and a vertically traversable reflow unit.
ELECTRICAL SILICON STEEL STRIP

SMS group supplies processing lines for the production of silicon steel from non-grain oriented grades to high-permeable grain oriented grades. The lines are completely supplied from a single source, including mechanical, process and furnace technology as well as electrical and automation systems and process know-how. Furthermore, all lines feature special equipment tailor-made for the particular requirements of silicon steel strip.

PROCESS KNOW-HOW

In cooperation with MET/Con, SMS group offers process support for all grades and production routes. This covers both metallurgical and design activities as well as support during commissioning and operation. The experts involved look back on long production experience and offer full parameter sets from steelmaking to final processing. This ensures safe production also of difficult and high-quality grades. Furthermore, operational costs can be minimized, for example through greatly reduced use of alloying elements.

SILICON STEEL GRADES AND APPLICATIONS

There are two groups of silicon steel strip (also known as electrical steel strip): non grain-oriented (NGO), and grain-oriented (GO). In NGO electrical strip, the iron grains are distributed in such a way that the material has largely the same magnetic properties in all directions within the sheet plane. That is why NGO electrical strip is mainly used in rotating machines with alternating field orientation. In GO strip, the grains are sharply oriented in one direction. Due to the high permeability and lower losses in this preferred direction, GO electrical strip is typically used in static machines such as transformers.

Grain-oriented electrical strip is used in energy-efficient transformers. (© Dieter Schütz/PIXELIO).

Non grain-oriented electrical strip is used in wind turbines for electricity generation (© Thorsten Wengert/PIXELIO).
SPECIAL EQUIPMENT

All equipment is tailor-made for the particular requirements of silicon steel strip. Furthermore, the equipment is designed and constructed in such a way that all components mesh with each other, and maximize the capacity, quality and overall performance of the lines. One example is the adaptation of the turbulence pickling system. A special tank shape and corresponding equipment in the circuit system provide largely automated siliconoxide sludge removal. Smooth strip running is supported by heating the coils as well as the strip edges.

This special handling also reduces strip damage and tearing. Since the coating has a decisive influence on the material properties of the final product, the special roll coaters allow a high-precision coating. Top coating quality is additionally ensured by exact temperature control of the coating medium in the circulation system.
NON-GRAIN ORIENTED PROCESSING LINES

The most important processing line for fully-finished non-grain oriented (NGO) material is the annealing and coating line (ACL). One highlight is the recrystallization furnace with advanced water cooling and a hydrogen content of up to 100%. Also important is the roll-coater technology with closed-loop thickness control. For contactless drying of the coating, a floatation furnace with a high specific heat transfer is installed.
In its new annealing and coating line, ArcelorMittal St-Chély d’Apcher, France, processed the first coil in March 2013. Thanks to good preparation by all participants, the commissioning was done quickly within a few weeks. Already one month after the furnace had dried out, the production reached the nominal rate. With the new line, ArcelorMittal St-Chély d’Apcher is drastically increasing its production capacity of high-grade non-grain-oriented electrical steel strips (NGO). Among other products, the furnace processes the newly developed iCARe™ material by ArcelorMittal which helps automakers to create environmentally friendly mobility solutions for a greener world.

In the annealing and coating line, the internal microstructure of the electrical steel strip is adjusted during the annealing process. The material is then provided with an insulating layer. The strip is heated up to 1,100°C by means of inductors and electrical heating elements in the horizontal annealing furnace. The atmosphere in the furnace comprises a nitrogen-hydrogen mix whereby the furnace can be operated with hydrogen content up to 100%. This reducing atmosphere helps to achieve a particularly oxide-free and clean strip surface, which is important for a high-quality material grade. Furthermore, the careful and slow cooling of the material is important for the microstructure. For this reason, the strip is first cooled down at a very accurate cooling rate in the slow-cooling section and then in the quick-cooling section. Due to the high annealing temperatures and the very high hydrogen content in the furnace, ArcelorMittal achieved very good material properties right from the start. Especially the core losses are already at the level of those attained by the best producers in the world.
GRAIN ORIENTED PROCESSING LINES – LINE CONCEPTS

The production of grain-oriented silicon steel involves several strip processing lines, mainly the annealing and pickling Line (APL), the decarburizing and coating Line (DCL) and flattening and coating Line (FCL).

ANNEALING AND PICKLING LINE (APL)

In the annealing and pickling line grain-oriented as well as non-grain oriented hot strip is annealed and descaled. Special components are the side trimmer with edge warming, the furnace and the turbulence pickling tanks with special silicon desludging system.

DECARBURIZING AND COATING LINE (DCL)

During decarburization annealing in the DCL, the atmosphere is humidified in the soaking section of the furnace to reduce the carbon content and thus avoid magnetic aging of the product. As an option, the furnace can serve also for nitriding. After annealing, the strip is coated with water-based magnesia slurry in a horizontal coater with closed-loop thickness control, temperature control and special conditioning of the coating solution.

FLATTENING AND COATING LINE (FCL)

In the flattening and coating line the goal is to apply and dry the tension-active solution and to improve strip flatness. A horizontal coater with thickness control and accurate conditioning of the coating solution applies the isolation coating. A special feature is the filtration of the MgO solution, leading to a 90% reduction in water consumption. The drying furnace is divided into a radiant-tube section for drying and a direct-fired section for sintering. The thermal flattening takes place in a horizontal furnace with tight strip tension control to avoid negative impact on final properties and to ensure improved flatness.
SEVEN SILICON STEEL PROCESSING LINES FOR SHOUGANG, CHINA

For Shougang Qian’an, China, SMS group had supplied seven lines for NGO and GO silicon steel strip by 2013. The annual output of GO strip including highly permeable material adds up to 180,000 tons. Besides the mechanical equipment, the scope of supply comprised the complete engineering and the manufacture of the electrical and automation systems as well as the supervision of erection and commissioning of all lines.

The hot strip is initially annealed and descaled in two annealing and pickling lines that are capable of processing grain-oriented and also non-grain-oriented grades. The cold rolling process is followed by recrystallization and decarburization in three decarburizing and coating lines which also serve to apply a layer of magnesium oxide to the strips to prevent them from sticking to each other during the subsequent long-term high-temperature treatment needed for metallurgical reasons. Together with an insulation varnish, this serves to introduce inherent stresses and hence improve the magnetic properties. Two flattening and coating lines were established for final thermal leveling and for the application of an insulation coating.

The grain-oriented silicon steel strip substantially contributes to the energy efficiency of electrical systems, e.g. energy-efficient transformers require grain-oriented electrical sheets with very low core losses.

All lines are equipped with horizontal loopers, including strip trolleys which permanently support the strip and thus help prevent damage to the strip surface.
Ares supplied two furnaces for Wisco’s new two flattening and coating lines in China. These two lines are used to enhance the production of HGO grades with an annual of around 180,000 tons. Both furnaces were successfully commissioned in 2012. Without a stop for the first five months after start-up, both furnaces have been operating and produced, among other grades, HGO materials in the low-temperature mode. The furnaces feature new technologies for thermal flattening as well as for cooling, which improve surface quality and process control.
STAINLESS STEEL PROCESSING LINES

POWERFUL PROCESSES FOR STAINLESS STEEL STRIPS

SMS group offers perfected concepts for all treatment stages of stainless steel strip characterized by efficient furnace and descaling technology, sophisticated production models and powerful environmental technology. All this leads to low production costs, high energy efficiency and outstanding environmental compatibility. Another advantage: SMS group supplies the complete lines from one single source with integrated electrical and automation systems.

LINE CONCEPTS

SMS supplies all significant line types for stainless steel strip processing from annealing and pickling lines for hot or cold strip to integrated rolling, annealing and pickling lines as well as continuous tandem cold mills and bright annealing lines.
STAINLESS STEEL STRIP PROCESSING LINES – FURNACE TECHNOLOGY

The Drever furnaces are designed to optimize energy utilization and environmental compatibility. The strip is pre-heated in a radiation zone which operates with the exhaust gases from the downstream heating furnaces. To increase the thermal efficiency, the combustion air is preheated in a recuperator using exhaust air. The process parameters are set and controlled by a mathematical model over the entire annealing cycle, which is also combined with the pickling model to match up and optimize both processes. More than 25 Drever furnaces for stainless steel strip processing have been ordered since the year 2000 worldwide.
WATER COOLING FOR HOT-STRIP

In hot-strip processing, special water cooling technology ensures better strip quality due to faster cooling and better control of the last heating zone. The efficient system results in a shorter cooling section and massive electrical savings. Furthermore, the impact on the environment is minimized because there are no dust emissions and no vibrations or noise.

MIST COOLING FOR COLD-STRIP

The mist cooling technology reduces the length of the energy-consuming air-cooling section and eliminates the final cooling performed by water, since this can generate cooling buckles. In total, 17 annealing and pickling lines have been equipped with mist cooling sections. Electrical energy is saved thanks to reduced blower motor power and exhaust motor power. Moreover, water consumption can be reduced drastically. This adds up to annual operational savings which significantly reduce production costs.
STAINLESS STEEL STRIP PROCESSING LINES – PICKLING TECHNOLOGY

The pickling process stands for high surface quality with minimized energy and acid consumption.

The acid concentration in the pickling tanks is continuously adapted to the type of material handled. A pickling and dosing model ensures a consistent pickling quality and minimizes acid consumption. To reduce energy consumption to the lowest possible level, the model is coupled with the furnace control model.

SPECIAL EQUIPMENT

To support the pickling process the strip surface is subjected to abrasive cleaning by means of oscillating washing brushes. These brushes are a new development and specifically tailored to ensure efficient cleaning and a longer brush service life of up to 40%.

The environment-friendly and cost-saving technologies for water and air treatment ensure the effective use of all resources in conformity with the toughest requirements. To prevent nitrogen oxide from escaping via the exhaust air system of a pickling facility, a DeNOx system with selective catalytic converters is installed. A fully automated acid purification unit and an electrolyte recovery system reduce the costs for fresh chemicals and operational expenditure.
ELECTROLYTIC PICKLING

The electrolytic pickling section is characterized by the efficient utilization of energy due to the high electrolyte flow velocity and the proven design with separated electrodes. High operating efficiency is thus guaranteed since only small losses occur between cathode and anode, which results in 10% lower energy consumption. Spraying lances in the entry and exit sections and further nozzles in the side section enable high circulation of the pickling medium and minimization of sludge deposits.

TURBULENCE PICKLING

The specially designed turbulence pickling tank is characterized by a low volume of acid. Sludge deposits are minimized by the use of spraying lances in the entry, exit and side sections and by a patented tank bottom design. The patented immersion cover forms the top surface of the pickling channel and thus ensures efficient sealing of the pickling tank. This results in lower evaporation losses, which in turn enables considerable savings due to the reduced consumption of energy and acid.
WORLD’S BIGGEST ANNEALING AND PICKLING LINE FOR HOT STRIP AT TISCO, CHINA

SMS has commissioned the world’s most productive annealing and pickling line for hot strip for the Chinese stainless steel producer TISCO (Shanxi Taigang Stainless Steel Company) This line processes one million tons of ferritic and austenitic stainless steel strips per year.

With this annealing and pickling line TISCO distinctly enhances its capacities for high-grade stainless steel strips and at the same time cuts production costs. The line possesses modern processing and environmental technology to meet all environmental standards in respect of exhaust air and waste water in a very efficient and flexible production process. The high degree of automation as well as few maintenance activities contribute to a reduction of operating costs. The facility went successfully on stream in 2014.
The annealing and pickling line for stainless steel hot and cold strip is an integral part of a new cold rolling mill for stainless steel in Alabama, USA, owned by Outokumpu Stainless Steel USA. The line is able to produce flexible hot and cold strip as well as very thick material (up to 10 mm). The yearly capacity is 750,000 tons including AISI 200, 300 and 400 grades. The line went on stream in 2011 with excellent results so far.

The scale breaker operates with a tension up to 90 tons.

The line features a horizontal furnace by Drever.

Entry section of the pickling section, suitable for hot and cold stainless steel strip.

Besides turbulence pickling, the line also features electrolytic pickling sections.
ALUMINUM PROCESSING LINES

SMS group offers aluminum-strip finishing lines tailored to suit the needs of the international market. One unique selling feature is the company’s ability to supply the modularly designed lines, including several high-performance components, completely from one single source. That means high-performance process components, powerful and energy-efficient furnace technology, reliable mechanical equipment, and electrical and automation systems - all available from a one-stop shop. In this way you can use our innovative process lines and components to produce a broad spectrum of high-quality aluminum alloy strip and plate for a wide variety of applications – efficiently and cost-effectively.

There are multiple uses for the final products, above all in fields such as the packaging, building, furniture, automotive and aerospace industries. Increasingly successful in recent years, SMS has built several new aluminum strip processing plants and has also performed complex revamps. Furthermore, SMS has acquired new orders for all the major types of processing lines.
- Heat and chemical treatment lines
- Color coating lines
- Anodizing and coloring lines

Since 2000, SMS has acquired orders for 26 lines. Among our customers, for example, are ASAŞ Alüminyum, Turkey, Corus Aluminium, Belgium, Amag Cold Rolling, Austria, Hydro Aluminium, Germany, or Madar Coil Coating, Syria. Also new on our books is the heat and chemical treatment line for Ma’aden-Alcoa Joint Venture, Saudi Arabia. Further new orders each comprise a color coating line for can material for Henan Zhongfu, Shandong Nanshan and Tianjin Zhongwang, all located in China.
HEAT AND CHEMICAL TREATMENT LINES

The use of aluminum as a lightweight construction material in automobiles continues to be on the rise. Subsequent to the cold rolling process, the aluminum sheets have to undergo a heat treatment to regain the formability as well as the required material strengths. Especially the heat treatment and the cooling of the strip play a major role. To increase flatness, the strip has the possibility to run through a tension leveler. The strip surfaces must be cleaned before they are coated. The chemical treatment prepares the strip for transportation and further processing. These processes can take place separately in different facilities or be combined in a heat and chemical treatment line, which can provide financial benefits.

The furnace and cooling technology is the heart of the process. The strip enters a floatation furnace where it is guided sinusoidally in a contactless floating mode. It is heated up and kept at the required strip temperatures for the necessary time, so that the aluminum alloy obtains its structure. Especially 6xxx automotive alloys as well as 2xxx and 7xxx aerospace alloys require high cooling rates up to approx. 400 Kelvin per second. The cooling process is executed as a combination of water and air cooling. A mathematical model calculates the necessary settings for the annealing and cooling process under consideration of the mechanical properties.

After the furnace, some alloys pass through a tension leveler to improve the required strip flatness. Depending on the material requirements, the machine is able to operate without switching the leveling cartridge in either stretch bending or pure stretch mode. The settings are specified by a physical process model.

In the subsequent spray-cleaning process the remaining surface impurities will be removed and the strip surface will be activated. Here, special nozzles are used to avoid clogging and the nozzle bars are switchable for higher process flexibility.

Subsequently, a chemical coating is precisely applied onto the strip surface by a vertical or horizontal roll coater. The strip is coated evenly on each side with predefined surface thicknesses. Alternatively, a spray passivation can be used instead of roll coating.
The lines feature a high-performance floatation furnace for aluminum automotive qualities. Important for the product quality is the water-quench, which at the same time ensures high cooling rates and good strip shape. Controlled and stable cooling is ensured by a pre-defined cross-bow. A special sealing unit prevents premature cooling. Another special feature of the furnace is the eco-friendly process control.

Operation is controlled by a physical process model and a production planning model with physical transient state calculation.

During cold rolling, the aluminum strip solidifies and must be annealed to regain its formability for further processing. These lines also homogenize and solution-anneal alloys that can solidify due to special intermetallic precipitates. To achieve the microstructure necessary for the desired mechanical properties, the material is heated up to 570 degrees Celsius, then rapidly cooled in a controlled manner. It is imperative that the sensitive surfaces are not supported by rolls during heating, which is where the convection strip floatation furnace comes in. Furthermore, the strip receives a chemical treatment that prepares the surfaces for subsequent painting.
HEAT AND CHEMICAL TREATMENT LINE FOR MA’ADEN ALCOA JOINT VENTURE

For a new continuous heat and chemical treatment line at Ma’aden-Alcoa, all plant components including electrical and automation systems were supplied by SMS from a single source. SMS was responsible for the design, manufacture, erection supervision and commissioning of the line in the Ras al Khair plant in Saudi Arabia.
The technical highlights of the line are the strip flotation furnace, the tension leveler and the chem-coater. The equipment paves the way for Ma’aden-Alcoa to enter the market for aluminum car body sheets. The line is able to produce 60,000 tons of annealed, cleaned and chemically treated strip material. In March 2015 the first aluminum coil was successfully heat-treated and chemically treated in the new line.
COLOR COATING LINES FOR ALUMINUM STRIP

Color coating lines apply a high-quality coating to the strip so that it can be used directly for processing into end products. This saves costly process stages. SMS group delivers color coating lines for various applications of aluminum strip. The lines differ depending on the final use of the material. For example, material for the building industry often requires three coatings (passivation, primer, paint) while can-end stock grades only need two layers (passivation, paint) and are thinner. SMS has acquired orders for all kinds of lines in the last few years. The lines are delivered completely from a single source and feature several outstanding processes.

Vital for the high performance of the color coating lines are the process components for cleaning and pickling to attain the surface cleanliness required for color coating. All elements are designed for excellent surface qualities at minimum resource consumption.

The high-performance flotation oven to dry the solvents stands out for even heating and cooling performance as well as exceptionally high efficiency and eco-friendliness. The strip is transported contactless through the whole furnace. This is possible because nozzles keep it afloat on an air cushion. The elimination of mechanical contact in the furnace translates into a fault-free strip surface.

The tension leveler features different leveling cartridges and operating modes to suit the different material properties and dimensions. The adjustment positions of the leveling rolls and the required elongation are preset via the level 2 automation. The setting values are precalculated by a physical model and optimized during application.
The flue gases of the oven are burned in a regenerative thermal oxidizer system (RTO) with a thermal efficiency of 98%. Depending on the solvent content in the exhaust air, the afterburning system and even the oven itself can be operated without additional energy input (autothermal mode).

Here is the coater arrangement in a typical can-end stock line with a vertical roll-coater for passivation and two back-up roll coaters (one only for the top side) for fast color changes. All systems are extremely precise and reliable. A special feature to ensure precise thickness is the closed-loop thickness regulation.

It is possible to treat the strips with wax for which purpose a vertical roll coater with heated rolls is integrated into the exit section of the line. The wax layer protects the material and improves its deep-drawing properties.
COLOR COATING LINE FOR ALUMINUM STRIP FOR TIANJIN ZHONGWANG

Tianjin Zhongwang has ordered a color coating line for aluminum can material. In the seaport Tianjing, 82,000 tons of strip per year will be produced as of 2016.

All plant components for the new color coating line for Tianjin Zhongwang (Tianjin Zhongwang Aluminum Co., Ltd.) will be supplied by SMS group from a single source. An outstanding feature of the plant design is the compact coating process. The chemical pre-treatment section, the subsequent strip coating process and the drying oven are perfectly harmonized. For many products, the drying oven uses only the energy recovered from the process. This ensures low consumption of resources and energy while achieving a high product quality.

In addition to the coating process equipment, SMS' scope of supply comprises all mechanical equipment and the entire electrical and automation systems for the lines. Beside the design and manufacturing of the equipment, SMS group will be responsible for the supervision of installation and commissioning. To attain a strip surface condition that complies with the requirements of color coating, the strip will first be subjected to intensive cleaning and then covered with a passivating chemical coating. Two finish coaters using a high-quality control system ensure a uniform coating result that perfectly complies with the specified coating thickness, while keeping media consumption low. The solvents will be evaporated without any contact in a floatation oven, with the paint on the strip surface curing in the process. Along the entire furnace length, the strip will be uniformly heated by hot-air jets while being carried by an air cushion in a floating position. The fact that there is no mechanical contact between the strip and any part of the furnace guarantees an impeccable surface quality.

The evaporated solvents will be combusted in a highly efficient thermal process in a regenerative thermal oxidizer (RTO). This solution makes it possible to heat-treat a wide range of products without any external energy input (autothermal operation).
The color coating line at Tianjin Zhongwang, China, is 213 meters long. Entry and exit sections are located on the same side, which is advantageous for coil handling. The main components of the line are two uncoilers and cross-cut shears, a stitching machine, entry accumulator, cleaning section, chemical coater, two finish coaters, a floatation oven, exit accumulator, inspection section, wax coater, oiling machine, side trimmer, flying shear and two coilers.

The line is designed for strips with a thickness of 0.15 to 0.5 millimeters and widths ranging from 950 to 2,000 millimeters. In the process section the strip will be coated at a process speed of 250 meters per minute, whereas in the entry and exit sections speeds of up to 300 meters per minute can be attained. The production range includes 3xxx series aluminum alloys, as well as 5052 and 5182 alloys.
ANODIZING LINES FOR ALUMINUM

COLORFAST AND ALMOST WEAR-RESISTANT

The anodizing process generates a protective oxidic coating or film on the aluminum strip. This coating protects even deeper material layers against corrosion. Material wear due to abrasion (removal at the surface) is reduced and lifetime increased. Furthermore, the color coating applied is UV-resistant and less susceptible. Irrespective of the light conditions, the color quality can be preserved at a consistent level over the long term. The major part of the anodized and colored aluminum strips is employed in the construction industry, e.g., for building façades. In view of its aesthetic appeal and durability, the material is also used to make suitcases and kitchen fronts.

The process section starts off with the alkaline cleaning and degreasing equipment. An alkaline solution serves for roughening the surface. Then neutralization is accomplished with the aid of acid. This is followed by the anodizing process itself. The strip is charged by means of an entry-side current roll. Cathodes are fitted in an electrolytic bath to discharge the strip again. The result of this electrochemical process is the formation of a transparent, colorless oxide layer on the strip surface that ensures excellent surface hardness and resistance to corrosion. Subsequently, the strip may be colored in the electrolytic color bath with the color penetrating deeply into the surface pores and its intensity being precisely controlled. In a hot sealing bath with nickel content, a compaction process closes the pores and permanently stores the pigments. The strip may finally be laminated with a foil.

Horizontal loopers ensure a constant process speed.

Surface quality is checked in the inspection stand.
SMS SUPPLIES A FURTHER ANODIZING LINE TO COIL

The comprehensive technological know-how and the process expertise were the decisive factors for Coil GmbH, Bernburg, Germany, to again decide in favor of SMS as the supplier of a further anodizing line. This new line is the first one of its kind to process aluminum strips having a width of up to 2,000 millimeters and thicknesses up to 3.5 millimeters. With these record dimensions, Coil wants to expand its market. A further highlight of the line is an electrolytic color bath that is being developed by SMS in cooperation with Coil. Already in 2005, SMS commissioned the first anodizing plant at Coil. The new line, which is designed for an annual capacity of 15,000 tons, will be erected alongside the old one.

SMS is responsible for the design and manufacture of all plant components except for the laminating machine. In addition to the process equipment already mentioned above, the line comprises a payoff reel, stitcher, entry-side looper, exit-side looper, and a tension reel. Erection supervision and subsequent commissioning are also included in the scope of supplies. Besides the mechanical and processing equipment, SMS will provide the electrical and automation equipment.
HEAVY GAUGE CROSS-CUT SHEARINg LINES

COST-EFFECTIVE MANUFACTURING OF PLATES WITH LOW INTERNAL STRESSES

There is a growing demand for plates with low internal stresses and homogeneous distribution of residual stress across the cross-section, particularly in the thickness range of 15 to 25 mm. These plates are usually manufactured on heavy plate lines. The much smaller heavy cross-cut shearing line is an ideal alternative for hot strip up to 25 mm thickness.

EXCELLENT PROPERTIES

Ever more application fields are emerging for the steel plates produced on this line, including machine and plant construction, tank, pipeline and bridge construction, and safety containers. Plates with these properties can be processed on laser cutting systems without residual stresses that cause deformation on workpieces.

X-PRO® LEVELER

The heart of the line is an integrated leveler with hydraulic screwdowns, individual roll adjustment, counter-bending system, and a process model for adjusting the leveling rolls. First, the leveling machine bends the plates thoroughly to correct unknown stress and deformation states and to achieve a defined state. Then it straightens them again. This controlled alternating bending and unbending eliminates shape and flatness faults. The extremely precise dynamic adjustment of the leveler also makes it possible to minimize the residual tension in the material. Equally important, the hydraulic adjustment and the counter-bending system of the roll sets compensate deflections.

SMS offers two concepts for heavy cross-cut shearing lines. The conventional concept with a pre-leveler and a plate leveler in the exit section and a compact concept with a high-precision leveling machine in the entry section.
HEAVY GAUGE CROSS-CUT SHEAR LINE FOR HANDAN

At the end of July 2010, Handan Iron & Steel officially accepted the cross-cut shear line made by SMS, which produces 450,000 tons of high-quality steel sheets per year. The strip material comes from a hot strip mill which was likewise supplied by SMS and which is able to coil strip with a thickness of up to 25.4 mm. Handan uses the equipment for the efficient and economic production of steel sheets in this thickness range. The steel sheets are excellently suited for all areas of application requiring material with high load capacity and good processing properties along with low residual stresses over the full material thickness. In addition to the mechanical equipment, the SMS package also contained the complete electrical equipment, including Level 1 and Level 2 systems.

A payoff reel with support bearing unwinds the coils and the strips run into the line; payoff is assisted by processor rolls, hold-down rolls and pinch roll units. The core unit of the line is the leveler which levels the already cut sheets. The leveler rolls are individually adjusted and controlled by a process model; a counterbending system eliminates any spring of the leveler roll sets.

At strip speeds of up to 40 m/min, a flying shear divides the strip into sheets of 2 to 16 m length. Thanks to the uniform cutting geometry, high-quality cuts are guaranteed. The leveled steel sheets are piled, and the piles are carried away by cross-conveyor systems.
"The information provided in this brochure contains a general description of the performance characteristics of the products concerned. The actual products may not always have these characteristics as described and, in particular, these may change as a result of further developments of the products. The provision of this information is not intended to have and will not have legal effect. An obligation to deliver products having particular characteristics shall only exist if expressly agreed in the terms of the contract."