ALUMINUM-STRIP PROCESSING LINES
Extensive know-how and process understanding
HIGH-QUALITY ALUMINUM STRIP

Extensive know-how and process understanding about aluminum strip processing lines

As a global leader in metallurgical plant and rolling mill technology, SMS Siemag also knows all there is to know about constructing and installing aluminum strip processing lines, plus the processes involved.

A special thing is our ability to supply the modular designed lines completely from a single source – including highly advanced process components, powerful and eco-friendly furnace technology, reliable mechanics, as well as electrics and automation. 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 automotive and aerospace industries. Increasingly successful in recent years, SMS Siemag has built several new aluminum strip processing plants as well as performing complex revamps. Furthermore, SMS Siemag attracted new orders for all the major types of processing lines.

Included in our scope of supply are color coating lines, combined annealing and passivation lines, and anodizing lines.
Since 2000, SMS Siemag has attracted orders for 20 lines. Among our customers were for example ASAS Alüminyum, Turkey, Corus Aluminum, Belgium, Amag Cold Rolling, Austria, Hydro Aluminium, Germany, or Madar Coil Coating, Syria. Also new on our books are for example another anodizing line for Coil GmbH, Germany, plus an annealing and passivation line for Ma’aden-Alcoa Joint Venture, Saudi Arabia. A further new order includes a color coating line for can material for Henan Zhongfu, China.
LINE DESIGNS

All aluminum strip processing lines from SMS Siemag are tailor-made to your requirements and modular in design. Depending on the aluminum alloys and qualities as well as the strip dimensions you want to produce, your plant comes equipped with the right technologies and components.

**Color coating line**
These lines apply a high-quality coating to the strip so that it can be directly processed into end products. That saves costly process stages. As a rule, the color coating consists of several layers. First in line is a chem-coater which applies a conservation layer, followed by drying. Next, a primer-coater adds an adhesion agent, and finally one of two integrated finish-coaters applies the top coat.

**Annealing and passivation line**
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 to as much as 600 degrees Celsius, then rapidly cooled in a controlled way. It is imperative that the sensitive surfaces are not supported by rolls during heating, which is where convection...
Service lines such as slitting, cross-cutting, and tension leveling plants for further processing the refined strip complete our product range.

The layers of primer and finish paint are each dried separately in a high-performance convection oven (catenary or floating type). Integrated in the plant is an energy-efficient exhaust air cleaning and energy recirculation system that treats the exhaust air.

Typical plant parameters:
Strip thickness: 0.15 – 2.0 mm
Strip width: 700 – 2.100 mm
Capacity: up to 150,000 t/a

Strip floatation furnaces come in. The strip travels through them contact-free in a sinus shape. Furthermore, the strip receives a passivation in these lines that prepares the surfaces for subsequent painting. The material produced in this way is used for instance in the automotive and aerospace industries.

Typical plant parameters:
Strip thickness: 0.3 – 6.0 mm
Strip width: 700 – 2.650 mm
Capacity: up to 200,000 t/a

The resulting color coating is UV-proof and durable. Wherever esthetically pleasing, non-corrosive strip material with a long service life is required (e.g. in architecture), this type of aluminum plate is the ideal solution.

Typical plant parameters:
Strip thickness: 0.5 – 3.5 mm
Strip width: 800 – 2.300 mm
Capacity: up to 50,000 t/a
Vital to the high performance of our aluminum strip processing lines are the process components for cleaning, alkaline pickling, neutralizing, and anodizing the strip surfaces. All the elements are designed for excellent surface qualities at minimum material consumption. You benefit from our many years of experience because the components are sophisticated, with a high degree of automation.

Even more, SMS Siemag knows everything about the process technology and operation of these plant parts that are often crucial to surface quality and production costs.

Spray cleaning and cascade rinsing in an aluminum strip processing line.

**Tension leveling lines**

You use these machines to make sure the strip is perfectly flat. That is usually a top priority. The tension leveler removes any unflatness such as waves, cambers or longitudinal bows and crossbows. Also included in the tension leveling line is cleaning the strip surfaces, which involves stripping them of rolling oil, abrasions from the rolling process, and other contaminants. The alkaline cleaning phase finishes with rinsing and hot-air drying. It is important that the strip edges are straight and the strip is cut to the right width. This is where the integrated side trimmer comes in.

Further components are coilers and shears in the entry and exit areas as well as a stitcher to join the coils.
TENSION LEVELER

Typical of our efficient mechanical equipment is the tension and bending leveler. It applies strip tensions of up to 50 t to achieve the specified strip flatness.

The machine consists of an array of bending and correction rolls as well as an upstream and a downstream set of S-rolls to create the tension. What happens here is that the combined effects of tensioning and bending exceed the yield strength of the strip as it passes through the rolls. As a result, the fiber lengths across the entire strip width are equalized and the internal stress in the material relaxed – for absolutely flat strip. There are various straightening cartridges and operating modes available to suit different material properties and dimensions. That means the tension and bending are always set optimally for your requirements. Integrated in the machine is a Level 2 automation system that adjusts the roll position and sets the necessary extension. The leveler can be used both dry and with minimal lubrication to avoid pick-ups and material adhesive. To allow the stitched seam that joins the aluminum strips to pass through, the tension leveler features a rapid-opening system.

For sensible surfaces and special strip dimensions the machine can be operated in pure stretch mode too. Then the strip is elongated without frequent bending.
COATER SYSTEMS

Uniform and high-precision strip coating with roll coaters

Roll coaters in aluminum strip processing lines apply various coats to the strip surfaces. Specifically, several rotating rolls on both sides transfer the medium evenly from a trough onto the surfaces. Now, depending on the intended use of the strip, the machine applies chemical passivating layers, primer, or paint coatings to one or both sides.

Efficient control technology and low consumption

All SMS Siemag roll coaters come with efficient control technology that guarantees a uniform and precise coating result in the required layer thickness at low medium consumption. Built in is a hydraulic rapid-opening function to make sure the coater can be opened or closed within two seconds. That ensures smooth passage of the stitched seams. Accommodating different strip speeds is easy using designs with different roll diameters.

Exact control of the coating process

To achieve the required coating result, a database is linked to the Level 2 automation system. It provides information for adjusting the roll speeds and positions as well as the pressing forces. Electric drives ensure uniform roll rotation. The position of the rolls is adjusted with high precision in a linear way by an electric motor system using spindle lifting elements. That eliminates deposits of coating medium which would cause flaws. Whenever necessary for maintenance or adjustment purposes, the coater deck can be moved back on rails.

Chem coaters

The chem coater applies a thin, even passivating layer. It contains two coater decks, each with an application and a pick-up roll. There are also several automated circulation systems for rapid coating changeovers. They ensure the rolls, troughs, and media systems can be automatically cleaned within two minutes for product changes.

Primer coaters

Some products require a primer coat between strip passivation and color coating. This is where primer coaters come in. Ideal for coating both sides of the strip simultaneously are S-roll coaters. A scraper system and solvents continuously clean the guide roll.
Finish coaters

As a rule, two coaters are used for the color coating stage itself. First, the strip runs through a U-coater (only the top side) and then through an S-coater (both sides). That's why two coaters are installed for coating the top side, making rapid product changes possible. The coater decks for coating the top side feature 3 rolls. You have the option of 2 or 3 rolls for the underside. If you choose a 3-roll coater deck, you can vary the roll positions depending on the product application (V position, inline, or only 2 rolls). Whatever finish coater you decide on, the guide rolls are continuously cleaned, while the underside coater deck of the S-roll coater can be moved out at the back.

<table>
<thead>
<tr>
<th>Chem coater</th>
<th>Primer coater</th>
<th>Finish coater 1</th>
<th>Finish coater 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical passivation agent</td>
<td>Primer</td>
<td>Paint</td>
<td>Paint</td>
</tr>
<tr>
<td>Both sides (optionally one side)</td>
<td>Both sides (optionally one side)</td>
<td>Top side</td>
<td>Both sides (optionally one side)</td>
</tr>
<tr>
<td>Vertical coater (two coater decks with two rolls each)</td>
<td>S-roll coater (two coater decks with two rolls each)</td>
<td>U-roll coater (one coater deck with three rolls)</td>
<td>S-roll coater (two coater decks with three or two rolls)</td>
</tr>
<tr>
<td>Annealing and passivation as well as color coating lines</td>
<td>Color coating lines for e.g. architecture grades</td>
<td>Color coating lines for e.g. can material and architecture grades</td>
<td>Color coating lines for e.g. can material and architecture grades</td>
</tr>
</tbody>
</table>
GATV CONVECTION FURNACES

Modular and compact in design, high-performance convection furnaces stand out for even heating and cooling performance as well as exceptionally high efficiency and eco-friendliness. All this requires ideal setting and control of the process parameters, ensured with a mathematical model. One highlight here is the floatation furnace, used especially in annealing and passivation lines as well as in color coating lines.

Floatation furnace

Nozzles in the floatation furnace ensure the strip travels contact-free through the furnace and air cooler in a sinus shape. This is possible because, throughout the furnace length, hot-air nozzles heat the strip evenly and keep it afloat on an air cushion. The elimination of mechanical contact in the furnace translates into a fault-free strip surface.

Furthermore, the low, even tension rules out heat creasing or dishing caused by excessive tension. Modular in design, the furnaces feature several heating zones that use turbines to generate an air channel consisting of top and bottom airflows. That makes them easy to control. The air is heated by burners that work with combustion air pre-heated to as much as 450 °C, yet require a very low energy input.

Annealing with high cooling capacities for automotive and aerospace qualities

The furnaces feature excellent technologies for stress-relieving annealing, homogenizing, and solution annealing in annealing and passivation lines. Even heating and cooling over the length and width of the strip creates uniform hardness and grain size – and high material quality.

As a rule, floatation furnaces heat the strip to temperatures of up to 600 °C, depending on the material grade. Crucial here is that the temperature is achieved throughout the strip. This annealing process restores the formability of the aluminum alloys. Finally, the strip is cooled.

It is vital in annealing lines for automotive or aerospace materials to achieve high cooling rates. This is why we supplement air cooling in our lines with a powerful water cooling system. Our GATV furnaces feature cooling technologies for all alloys including 6xxx and 7xxx series.
A high-performance water cooling system achieves the rapid cooling rates necessary in annealing lines for materials such as automotive or aerospace grades.

**Autothermal drying and curing of coatings**

Convection ovens are also used for drying and polymerizing coatings on aluminum strip. Then there are color coating lines, where solvents are evaporated at 230 to 260 °C to fuse the paint molecules and harden the paint.

You benefit because we analyze your product range and mix, then calculate the energy consumption and cost-effectiveness to determine the best type of heating for your ovens. Finally, after extraction, the flue gases are burned in an afterburning system (regenerative thermal oxidizer) with a thermal effectiveness of up to 98%. Depending on the solvent content in the exhaust air, the afterburning system can be operated without additional energy input.

This also applies to the ovens if an energy recirculation system is added to the configuration. We have already implemented strategies with autothermal oven mode for a large product spectrum.

**Mathematical model**

The entire thermal process is controlled by a mathematical model that calculates the treatment curve and target value parameters, ensuring high process reliability with excellent material quality.

The model draws on an extensive database and its own software, applying different calculation methods depending on the application required. It can be controlled both inline using the Level 2 automation, or offline by data input. All you have to do is enter the material data (type of alloy, dimensions) – for color coating also the paint data (solids content, density, necessary temperature) – and the model delivers the appropriate process parameters.

The GATV database contains the details of more than 350 solvents with the corresponding process parameters.

A mathematical model with its own database controls the thermal process and guarantees high process reliability and material quality.
HENAN ZHONGFU
Color coating line for aluminum can material

Contracted by Chinese aluminum producer Henan Zhongfu (Henan Zhongfu Industrial Co., Ltd.), SMS Siemag is building a color coating line for aluminum strip to supply the can industry. This very energy-efficient line will coat 70,000 t of aluminum strip per year with a high-quality color coating. Another standout feature is the impressive processing speed of the extremely thin material. Furthermore, the compact design means the plant is only 230 meters long. Moreover, it is possible to bypass the color coating section to produce only chemically coated material.

Everything from one source
This is a project where SMS Siemag is responsible for the engineering and manufacturing as well as the supervision of assembly and commissioning. We are also supplying not only the mechanical equipment, process technology components, and the furnaces, but also the electrics and automation. The material to be produced in Gongyi City, Henan Province in the mid-east of China is destined primarily for processing into beverage cans. However, the line can also produce aluminum strip for architectural applications.

Pretreatment with sulfuric acid pickling and chemical coating
First, the strip surface is pre-cleaned. Then the strip passes through a tension leveler to achieve the required flatness. Just as importantly for color coating, the surface must be scrupulously clean. The alkaline cleaning stage is followed by pickling with sulfuric acid. Finally, after cascade rinsing, a chem coater applies a preparing chemical to both sides which is then dried in a vertical furnace.

High-quality color coating and energy-efficient curing
Integrated for the color coating stage are two extremely precise roll coaters. The strip can be coated on one or both sides, while rapid paint changeovers are possible. Next, the solvents are evaporated contact-free in the GATV floatation oven and burned in a regenerative afterburning system with a high degree of thermal efficiency. This is how a large range of products can be thermally treated without any external energy input.
### Technological details

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissioning</td>
<td>2014 (planned)</td>
</tr>
<tr>
<td>Annual production</td>
<td>70,000 t</td>
</tr>
<tr>
<td>Strip width</td>
<td>850 – 1,900 mm</td>
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<tr>
<td>Strip thickness</td>
<td>0.15 – 1.0 mm</td>
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<tr>
<td>Entry speed</td>
<td>300 m/min</td>
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<tr>
<td>Process speed</td>
<td>250 m/min</td>
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<tr>
<td>Exit speed</td>
<td>300 m/min</td>
</tr>
<tr>
<td>Material grades</td>
<td>Aluminum and aluminum alloys (1xxx and 3xxx series as well as 5052 and 5182)</td>
</tr>
</tbody>
</table>

The entire thermal process is controlled by a mathematical model based on a database that contains the process parameters for more than 350 solvents.

**Post-treatment of the surfaces with wax and oil**

Now, the processed strip can be coated with wax. That’s why the line also features a vertical roll coater with heated rolls. The wax coating protects the material and improves its deep-drawing capability. There is also a DUMA oiling machine in the exit area which can apply a thin film of oil to the surfaces in an electrostatic process.
MA’ADEN-ALCOA JOINT VENTURE
Annealing and passivation line for automotive qualities

SMS Siemag is supplying all the plant components, complete with the electrics and automation, for the new annealing and passivation line at Ma’aden-Alcoa Joint Venture. Included in the order is the design, manufacturing, assembly supervision, and commissioning of the plant in the new facility in Ras al Khair, Saudi Arabia. Technological highlights of the line are the GATV strip floating furnace, the tension leveler, and the chem coater. All this is high-quality equipment that, after its installation, will enable Ma’aden-Alcoa Joint Venture to tap into the market for aluminum automotive plate. Starting in 2014, the line is to produce 50,000 t of annealed, cleaned, and chemically treated material per annum in a quality that is easy to form and paint.

<table>
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<td>- Exit</td>
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<tr>
<td>Material</td>
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Annealing and passivation line for aluminum automotive plates for Ma’aden-Alcoa Joint Venture.
It was a logical choice for Coil GmbH in Bernburg, Germany. Pleased with the good performance of the anodizing plant SMS Siemag installed in 2005, Coil decided to once again rely on the extensive technological know-how, process expertise, and vision of SMS Siemag for its planned capacity expansion. In particular, the competence in the special chemical treatment of the strip distinguishes SMS Siemag as preferred supplier for this kind of plant. The new line is the first of its kind able to process aluminum strip in widths of up to 2,000 mm and thicknesses of up to 3.5 mm. These record dimensions will give Coil GmbH the capacity to expand its market. Another special feature of the line is the electrolytic paint bath developed jointly by SMS Siemag and Coil. The new line, with an annual capacity of 15,000 t, will be erected next to the old plant and is scheduled to go into production in 2013.

**Technological data**

- **Commissioning**: 2013 (planned)
- **Annual production**: 15,000 t
- **Strip width**: 600 – 2,000 mm
- **Strip thickness**: 1.0 – 3.5 mm
- **Strip speed**
  - Entry: 30 m/min
  - Process: 15 m/min
  - Exit: 30 m/min
- **Material**: Aluminum alloys (1xxx, 3xxx and 5xxx series)
ASAŞ ALÜMINYUM
Color coating line for aluminum and steel

On December 15, 2010, SMS Siemag received an order from ASAŞ Alüminyum Sanayi ve Ticaret A.Ş. in Istanbul, Turkey for a color coating line for aluminum alloys, and galvanized steel strip. This line applies a high-quality color coating that eliminates the need for costly process stages downstream. Today’s modern coating systems mean one-side coating and fast color changovers are possible. Also included in the order are two slitting lines and one cut-to-length line.

Apart from the mechanical equipment, SMS Siemag is supplying the electrics and automation for the plants. They will go on stream in 2013 in the ASAŞ works near Akyazı in the Turkish province of Sakarya – some two hours’ drive from Istanbul.

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<td><strong>Strip width</strong></td>
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<td><strong>Strip thickness</strong></td>
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<td><strong>Strip speed</strong></td>
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<tr>
<td>- Entry</td>
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<tr>
<td>- Process</td>
</tr>
<tr>
<td>- Exit</td>
</tr>
<tr>
<td><strong>Material</strong></td>
</tr>
<tr>
<td>- Aluminum alloys</td>
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<tr>
<td>(1xxx, 3xxx, 5xxx, 6xxx and 8xxx series)</td>
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<tr>
<td>and galvanized steel</td>
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</table>
SMSiemag also supplied a color coating line to Madar Coil Coating in Damascus, Syria. The plant went into production in 2005. Included here are chem-, primer-, and finish-coaters as well as a floating furnace with air and water cooling.

### Technological data

**Commissioning**
- 2005

**Annual production**
- 30,000 t

**Strip width**
- 210 – 1,250 mm

**Strip thickness**
- 0.16 – 1.0 mm

**Strip speed**
- Entry: 130 m/min
- Process: 70 m/min
- Exit: 130 m/min

**Material**
- Aluminium alloys
- and galvanized steel

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**Commissioning**
- 2007

**Annual production**
- 20,000 t

**Strip width**
- 900 – 1,700 mm

**Strip thickness**
- 0.2 – 3.5 mm

**Strip speed**
- Entry: 60 m/min
- Process: 45 m/min
- Exit: 60 m/min

**Material**
- Aluminium alloys
  - (2xxx, 6xxx and 7xxx series)
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