HOT STRIP MILLS
Modernization concepts
ADAPTING existing hot strip mills to present-day market requirements

Owing to their size and high investment volume, hot strip mills have an extremely long life. Almost 40% of the 140 conventional hot strip mills currently in operation all over the world were built between 1960 and 1970. At that time, these mills were designed as fully continuous or three-quarter continuous mills featuring 5 to 7 roughing stands. Today’s mills attain annual productions between 3 and 5.5 million t in semi-continuous operation with 1 to 2 roughing stands. In addition, mechanical equipment, drive technology and process automation systems have been enhanced. Latest-generation hot strip mills with their lower power demand and higher productivity are able to produce at lower cost, with novel technologies resulting in an even better product quality.

Flexible concepts developed by SMS Siemag allow older hot strip mills to be modernized such that they meet today’s market requirements in exactly the same way as latest-generation mills. This also applies to the rolling of many innovative materials with the required dimensions.

More than 50*) new mills and a large number of modernizations carried out on more than 50*) hot strip mills over the past 15 years alone are evidence of our vast experiences.

We implemented many of these projects inclusive of electrical equipment and automation systems. Since 1990, we have built and successfully commissioned Level-1 and Level-2 automation systems for more than 40*) hot strip mills (new plants and modernizations). And in addition to automation, complete electrical equipment has been part of our supply package for a number of years already.

From these many modernizations jobs, four examples are presented in the following which were carried out in recent years and which featured very different requirements and design versions.

*) as per December 2005
<table>
<thead>
<tr>
<th>CONTENTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vast experiences with modernizations</td>
<td>2-3</td>
</tr>
<tr>
<td>Requirements</td>
<td>4-5</td>
</tr>
<tr>
<td>Analysis and studies</td>
<td>6-7</td>
</tr>
<tr>
<td>Implementation concepts</td>
<td>8-9</td>
</tr>
<tr>
<td><strong>Example:</strong> Hot strip mill Shanghai Meishan, China</td>
<td>10-13</td>
</tr>
<tr>
<td><strong>Example:</strong> Steckel mill Outokumpu Stainless</td>
<td>14-17</td>
</tr>
<tr>
<td><strong>Example:</strong> Hot strip mill Salzgitter Flachstahl</td>
<td>18-21</td>
</tr>
<tr>
<td><strong>Example:</strong> Hot strip mill 1 ThyssenKrupp Steel</td>
<td>22-23</td>
</tr>
<tr>
<td>References</td>
<td>24-27</td>
</tr>
</tbody>
</table>
MARKET DEMANDS on hot-rolled products

Over recent years, the use of innovative material concepts in the automotive industry has risen constantly. IF (interstitial-free) steels, owing to their excellent cold formability, are able to cope with both maximal deep-drawing as well as tensile stresses in the lower strength range. The strength of multi-phase steels (DP, TRIP, CP) is increased by incorporating hard phases in the microstructure in addition to soft phases. When used for the load-bearing components of motor vehicles, these materials enable ever lighter structures. On the one hand, this helps save fuel while improving passive safety on the other hand.

High-strength materials (for example S700M) are needed with thin final dimensions in the range of <2 mm. They are used, for instance, in components for building-construction and mobile cranes (crane jibs). Soft steel grades are required in thicknesses down to 1 mm and thinner to replace products that have so far been cold rolled.

The geometrical tolerances range from \( \frac{1}{4} \) to \( \frac{1}{2} \) of the relevant EN, ASTM or JIS standards. An excellent surface quality is required mainly for autobody parts, tinplate and rim steels.

All of these requirements have to be met by hot-strip suppliers under high cost pressure, while observing minimum delivery times.

DEMANDS on hot strip mills

The rolling mills consequently have to satisfy the following requirements:
- **Raising productivity** by increasing yield and availability, and by cutting down on maintenance
- **Improving the product quality**, for instance, by meeting close thickness and profile tolerances through powerful control or adjusting elements
- **More flexible rolling schedules** to safeguard short delivery times and economical rolling of smaller lot sizes
Example of the use of novel steel grades (TRIP steel).
ANALYSIS and STUDIES

ANALYSIS OF CUSTOMER REQUIREMENTS

Older rolling mills which do not or not fully meet these requirements can be brought up to the level of state-of-the-art facilities through adequate modernization measures.

Mill users employ different methods to determine the required modernization extent.

Some users decide on the basis of own analyses which plant components are to be replaced, supplemented or upgraded. In such a case, inquiries to the plant builders contain concrete requests, e.g. for a new roughing stand, a new crop shear or for the reinforcement of the coiler with clearly specified performance data.

Other users specify their goals, e.g. increase in production, observance of specified target profiles or the production of certain high-strength grades. They leave it to the plant builder to work out a tailored modernization concept within the scope of a study.

In any case it is the job and task of the plant builder to dimension the new facilities or those to be modernized, and to draw up suitable revamping steps.

Simulation of rolling processes using state-of-the-art parallel-processor technology.
STUDIES

Studies for drawing up modernization concept or analyzing weak spots are tailored to the specific needs and requirements of the customer.

Together with the analysis of the product spectrum, they determine the required forces and moments/torques of the plant components.

The production analysis provides information on bottlenecks in the mill’s process chain which impede an increase in production. FEM analyses serve to investigate the static loads on and the dynamic behavior of plant components. In conjunction with as-measured data from the mill, dynamic simulations, for example of drive trains, provide an insight into the behavior under extreme load conditions.

As a result, such a study makes proposals for modernization measures to be carried out to meet the goals specified by the customer.

### Proposal for modernization measures to be implemented

| - Analysis of the product spectrum (old/new)  |
| - Analysis of the production and spotting of bottlenecks |
| - Determination of required forces, moments/torques, setting ranges |
| - Strength analyses of relevant plant components |
| - Dynamic simulations |

FEM strength analysis. Finishing mill F1 – F3, total rolling force \( F_w \) = 45,000 kN.

Identification of production bottlenecks.
IMPLEMENTATION CONCEPTS

CONCEPTS

The implementation of modernization projects necessitates immense experience in this field and close cooperation with our customers. Consistent project management safeguards the quality of the individual components and meeting of the scheduled deadlines.

The actual state of the mill is precisely recorded, and the design and construction of the new facilities and of those to be modernized are adapted to existing foundations and other local conditions with the required amount of creativity. This, together with other suitable measures, enables minimum shutdown times for the installation of new or the revamp of existing equipment.

New facilities are completely assembled and piped in our workshop. All movements are initially performed mechanically and hydraulically, and the automation system is also frequently tested in the shop for optimization of the control parameters.

Prior to installing the facilities in the production line, extensive tests are run to ensure that the plant attains the planned production and quality level within minimum time after revamping.

MILL SHUTDOWNS

The shutdown periods are of particular importance in modernization projects. So as to avoid surprises during the shutdowns, nothing is left to chance. Preparatory work during routine maintenance downtimes and the installation of new or the revamping of existing facilities during extended shutdown periods (e.g. summer shutdown) are carried out according to detailed time schedules.

The facilities assembled and tested in our workshop are put together in parallel to the production line as far as possible and subjected to trial in “shadow mode”. Further tests are carried out after they have been installed in the line.
Preassembly of a heavy mill stand incl. function tests in our workshop.

With reference to a number of modernization projects implemented by us, we wish to show how 30- to 40-year-old hot strip mills can be modified to meet today’s market requirements and brought up to the performance level of new mills.

<table>
<thead>
<tr>
<th>Contract month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>START</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Procurement, manufacture and shop assembly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Transport to the site</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Plant shutdown (~ 24 h)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Removal of existing equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Foundation work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Installation of the new coiler</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No-load test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Startup and optimization</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Rough time schedule of a project.
The hot strip mill of Chinese steelmaker Baosteel Group Shanghai Meishan Corporation Ltd., Shanghai Meishan for short, had been in operation in Japan for 21 years before it was dismantled there and rebuilt and put into service in Meishan, approx. five hours by car north-west of Shanghai, in 1994. The order for the extensive modernization of the finishing mill was placed with SMS Siemag in 2000.

The goal of boosting production from 1.2 to 1.8 million tpy was already achieved a few months after recommissioning. With a daily production of more than 7,000 t, the annual production exceeds 2 million t.

The requested quality improvements were also successfully proved within the scope of the acceptance tests. On completion of the first revamp stage, SMS Siemag, in 2004, also received the order for revamping the roughing mill.

The targets are to raise production to 3 million tpy and to further improve the quality in terms of closer width tolerances and more rolling stability by avoiding transfer-bar cambering.

### MAIN FEATURES of the modernization

#### Stage 1

- **HGC**
  - F4 to F6 rolling force 30,000 kN
- **CVC**
  - F1 to F6 stroke ±100 mm
- **Work roll bending**
  - F1 to F6 bending force 1,200 kN per neck
- **New laminar cooling line**
  - 52 microzones, 16 trimming zones
- **New runout roller table**
- **New coilers 1 and 2**
  - Step Control, coiler 1 retractable

#### Stage 2

- **Descaler (primary)**
  - New 160 bar
- **Edger**
  - New edging force 7,000 kN
- **Roughing stand**
  - New rolling force 40,000 kN
- **Coilbox**
  - New transfer-bar thickness 20 to 40 mm, coiling speed up to 5.5 m/s
- **Crop shear**
  - New 50 mm x 1,320 mm, shearing force 9,600 kN
- **Descaler (secondary)**
  - relocation of existing descaler to in front of the new stand F0
- **Finishing stand F0**
  - New rolling force 38,000 kN
<table>
<thead>
<tr>
<th><strong>GOALS</strong></th>
<th><strong>RESULTS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage 1</strong></td>
<td></td>
</tr>
<tr>
<td>• Increase of production from 1.2 to 1.8 million tpy</td>
<td>• Thickness tolerance for strip thicknesses from</td>
</tr>
<tr>
<td>• Improved hot strip tolerances</td>
<td>1.2 to 4 mm: 99 % of strip length ≤40 µm</td>
</tr>
<tr>
<td>• Better coil quality</td>
<td>• Finished-strip temperature tolerance:</td>
</tr>
<tr>
<td></td>
<td>95.4 % within ±15 °C</td>
</tr>
<tr>
<td></td>
<td>• Profile tolerance for strip thicknesses ≤2.5 mm:</td>
</tr>
<tr>
<td></td>
<td>±25 µm of setpoint value</td>
</tr>
<tr>
<td><strong>Stage 2</strong></td>
<td></td>
</tr>
<tr>
<td>• Boost of production from 1.8 to 3 million tpy</td>
<td></td>
</tr>
</tbody>
</table>
Cont’d
Shanghai Meishan hot strip mill

**STAGE 1** of the modernization at Shanghai Meishan

During a 37-day shutdown (40 days were planned originally), the finishing mill up to the coiler was totally revamped. Hydraulic adjusting systems in the last three stands and hydraulic loopers ensure a stable strip flow and improved thickness tolerances. CVC PLUS shifting systems and work-roll bending systems in all of the stands offer adequate setting ranges to obtain the specified hot strip profiles from the beginning to the end of each rolling campaign. Good strip flatness always has top priority.

The new laminar strip cooling system in co-action with a corresponding process model ensures the demanded material properties. The two new, fully hydraulic coilers featuring Automatic Step Control take care of straight-edged strip coiling at defined strip tension.
STAGE 2 of the modernization at Shanghai Meishan

In the second revamping stage, the roughing mill is almost completely renewed. The two main shutdown periods last 25 and 30 days respectively. The roughing stands R1 and R4 to R6 as well as the edgers E4 to E6 are replaced by a reversing rougher with attached edger. Roughing stand R2 will be further used. The place of the old finishing stand F0 will be taken by a coilbox, and a new stand F0 will be arranged upstream of the finishing mill. The revamp job will be completed most probably in mid-2006.
STECKEL MILL
Outokumpu Stainless, Finland

The extension of the Steckel mill of Outokumpu, Finland, is an example of a very unconventional modernization job. The customer’s goal was to boost the annual production of the Steckel mill from 0.8 to 1.8 million t of stainless-steel strip.

MODERNIZATION STEPS and PROJECT SEQUENCE

The drastic increase in production was achieved by installing additional finishing stands downstream of the exit-side Steckel furnace.

Furthermore, the old pneumatic coiler was replaced by a hydraulic coiler with Step Control, and the laminar cooling section was renewed.

During the first 2-day shutdown, the roller tables in the area of the planned finishing stands were suspended from a roller-table bridge installed above. While production was in progress, a foundation pit (1) was prepared in which the foundations for the drive motors and the stands were completed. On operator side, a foundation block was poured on top of which the mill stands were almost completely assembled (2). Together with the foundation block, they were moved into the line (3), aligned and arrested during another shutdown of 5½ days.

Also during this shutdown, the new coiler was put into service and the old coiler removed. The Steckel mill with the new coiler attained its normal production level just two days after the end of the shutdown.

The foundations and the facilities for changing the rolls of the new stands were supplemented while production continued (4).

After the following 2-week summer shutdown that was used to complete the stands, the new finishing stands were successfully put on stream.

Before the revamp

After the revamp
**ORIGINAL STATE**

Production: 800,000 tpy

Steel grades: AISI 304, 316, 904L, 430

Thickness range: 2.3 mm to 12.7 mm

Width range: 800 mm to 1,625 mm

Coil weight: max. 30 t; 22 kg/mm

**GOALS**

Increase of production to some 1.8 million tpy

**MEASURES**

- New automatic slab feed
- New walking beam furnace
- Installation of 3 new finishing stands
- Provision of a new coiler
- New cooling section
- New Level-2 system and extension of basic automation
RESULTS

During a transition phase, production took place alternately in Steckel mode (5 or 7 passes on the Steckel mill stand) and in combination mode (3 passes on the Steckel mill stand, 1 pass each on the new finishing stands). As early as the second day after the summer shutdown, Outokumpu was able to produce its full production spectrum again. Four weeks later was the successful premiere of rolling in combination mode. The share of production rolled in Steckel mode decreased continuously until the end of the year, while production in combination mode increased to the same extent.

The availability of the new facilities (mechanical equipment and automation) of more than 96 % during the first 14 weeks and more than 98 % during the following 12 weeks, which had been contractually agreed upon for test operation, was reliably achieved and rose to 99 % by the end of the optimization phase.

Today the mill is run mainly in combination mode. Thicker strips – with thicknesses over 5.5 to 7.5 mm; depending on the width – are rolled in tandem mode (1 pass on the Steckel mill stand, 1 pass each on the new finishing stands).

SMS Siemag’s pass schedule model and the profile, contour and flatness model enhanced for this particular configuration take care of calculating the set-up values for the roughing mill, the Steckel mill, the new finishing stands and the coiler. Thickness deviations at the strip head of less than 100 µm underline the quality of the Level-2 system.

Cont’d
Outokumpo Stainless Steckel mill

![Diagram showing production phases and improvements over time]
The new finishing stands are on stream.

Laminar cooling section.
HOT STRIP MILL
Salzgitter Flachstahl, Germany

The hot strip mill of Salzgitter Flachstahl, Germany, which went into operation in 1963, has been continuously adapted to the ever increasing requirements of the market. The most recent modernization started in 2001 with the installation of a new sizing press, and was completed in 2003 with a new roughing stand with flanged-on edger and the provision of CVC® facilities and a work roll bending system in finishing stands F2 to F5. A new automation system was also installed.

INSTALLATION of roughing stand and edger

In terms of logistics, the installation of the new roughing stand and the new edger was the most demanding part of this modernization job. Within a shutdown period of just 18 days, the old components were dismantled, and the new ones installed and fully put into operation.

After the end of the shutdown, the mill went back into production as scheduled. And one week later, the mill already attained 80 % of its normal production level, thereby surpassing the very demanding goal.

The roughing stand and the edger were manufactured in our Hilchenbach workshop and preassembled inclusive of all pipelines.

Then our commissioning team tested all the main movements of the stand and the edger including preoptimization of the controls.

On completion of the workshop tests, the facilities were dismantled, reassembled next to the rolling line in Salzgitter and once again tested with the final electrical and automation systems. By adapting the housing contour (in the design phase) of the new roughing stand, the foundations remained almost unchanged after the old stand had been removed. Thanks to an innovative concept, the time needed to align the bedplates could be reduced from 36 to 12 hours. The assembled new roughing stand with a weight of approx. 850 t was moved on rails from the preassembly area to its final position. The edger reached its final position in the rolling mill with the help of a special lifting device and the bay cranes.
GOALS

- Boost of production
- Improvement of product quality
- Increasing the share of high-strength steel grades
- Preparing the hot strip mill to meet future market demands

MODERNIZATION STEPS

- 2001 New sizing press
- 2003 New roughing stand with attached edger
- CVC® and WR bending for F2 to F5
- 2003 New automation system for the roughing and the finishing mill

The new roughing stand is pushed into the rolling line.
COMMISSIONING
and production start

All the shutdown activities were timed down to the last minute. On completion of erection and connection of all utilities and cables, the roughing stand and the edger went on stream after less than 18 days, and seven hours before the contractually agreed deadline.

NEW AUTOMATION SYSTEM

Along with the mechanical revamp of the hot strip mill, SMS Siemag replaced the existing automation system. The new modular X-Pact system featuring process models based on physical relationships and extremely quick technological control systems is specifically tuned to today’s requirements of the rolling process.

IMPROVED PRODUCT TOLERANCES

Innovative solutions for optimizing the rolling process essentially contribute to the stable rolling of special materials with extreme dimensions. The thicknesses and width tolerances attained speak for themselves.

The demanded strip profiles are kept constant within very close tolerances from the strip head to its tail and from the beginning of a rolling schedule to its end. Specific strategies for the use of CVC® shifting and work roll bending systems enable also longer phases of a rolling schedule to be rolled in the same width without any undesired profile anomalies in the strip edge area.
The modernized finishing mill with CVC Plus technology.

Structure of the new automation concept of SMS Siemag.
HOT STRIP MILL 1
ThyssenKrupp Steel, Germany

The findings and recognitions obtained during the modernization of the Salzgitter Flachstahl hot strip mill with regard to the rolling of camber-free transfer bars have been incorporated into the modernization of the hot strip mill 1 of ThyssenKrupp Steel in Germany.

Extremely cambered transfer bars frequently resulted in unstable rolling of these bars in the finishing mill. Together with the integrated SMS Siemag automation system, the installation of new hydraulic sideguides upstream and downstream of the roughing stand in combination with hydraulic adjusting systems in the rougher lead to an improvement which surpasses even optimistic expectations.

MINIMIZING transfer-bar cambering

Cambers may form due to thickness wedges in the slab cross-section or asymmetric heating of the slabs. Nevertheless, a straight transfer bar is rolled through adequate interplay between sideguides and hydraulic adjusting system.
GOALS

- Minimizing transfer-bar cambering
- Improving rolling stability in the finishing mill

MEASURES

- Hydraulic adjusting system in R1
- New hydraulic sideguide
- Integrated automation concept

RESULTS

“Thanks to the new sideguides in combination with HGC in the roughing mill we stabilized the strip travel in the finishing mill and improved the geometry of the coils.”

(Dr. Helmut Osterburg, Head of Production, Bruckhausen Hot Strip Mill, ThyssenKrupp)
In the last 15 years alone, we built more than 50 new mills and carried out modernizations in more than 50 different hot rolling mills.

Since the end of the 80s, many of these projects have been implemented including electrical and automation systems. Since 1990, we have equipped 44 hot strip mills (new and modernized mills) with process models and basic automation systems.

We are strategically geared to the requirements of the market and the needs of our customers, and incorporate customer wishes in our decisions.

The longstanding contacts with our customers are maintained through:
- a regular exchange of information
- technological support
- participation in national and international events
- cooperation agreements (e.g. for product development)
- services

Our Service Division works out customized concepts for the fields of automation, maintenance and process technology. If required, our hotline is available to our customers around the clock. Via the Service Portal previously set up at the customer, our hotline staff can make an initial fault analysis.
**REFERENCES, 1990 to 2005**

**Modernizations**

<table>
<thead>
<tr>
<th>Category</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sizing presses</td>
<td>5</td>
</tr>
<tr>
<td>Roughing stands</td>
<td>6</td>
</tr>
<tr>
<td>Edgers</td>
<td>7</td>
</tr>
<tr>
<td>Coilbox systems</td>
<td>7</td>
</tr>
<tr>
<td>Shears</td>
<td>9</td>
</tr>
<tr>
<td>Descalers</td>
<td>15</td>
</tr>
<tr>
<td>Finishing stands</td>
<td>12</td>
</tr>
<tr>
<td>Hydraulic adjusting systems</td>
<td>55</td>
</tr>
<tr>
<td>CVC and CVC PLUS systems</td>
<td>64</td>
</tr>
<tr>
<td>Work roll bending systems</td>
<td>102</td>
</tr>
<tr>
<td>Hydraulic loopers</td>
<td>40</td>
</tr>
<tr>
<td>Laminar strip cooling systems</td>
<td>10</td>
</tr>
<tr>
<td>Coilers</td>
<td>26</td>
</tr>
<tr>
<td>Coiler modernizations</td>
<td>19</td>
</tr>
</tbody>
</table>
REFERENCES, 1990 to 2005
Modernizations

SIZING PRESSES (5)
Benefits:
- Higher throughput in steelmaking plant and continuous casting facility
- Reduced number of required slab sizes
- Greater flexibility in production planning

COILBOX SYSTEMS (7)
Benefits:
- Higher coil weights
- Extension of the product spectrum (smaller finished-strip thicknesses for harder materials)

ROUGHING STANDS (6)
Benefits:
- Increased production (fewer passes)
- Extension of the product spectrum (e.g. higher-strength steels)

SHEARS (9)
Benefits:
- Improved cropping configuration (head and tail crop cut) for increased rolling stability
- Extension of the product spectrum (e.g. higher-strength steels)

EDGERS (7)
Benefits:
- Improved width tolerances

DESCALERS (15)
Benefits:
- Improved strip surface quality
- Lower energy consumption for descaling
FINISHING STANDS (12)
Benefits:
- Higher production
- Extension of the product spectrum (e.g. higher-strength steels)
- Reduction of minimum finished-strip thicknesses

HYDRAULIC LOOPERS (40)
Benefits:
- Improved rolling stability
- Better width tolerances

HYDRAULIC ADJUSTING SYSTEMS (55)
Benefits:
- Better thickness tolerances
- Improved rolling stability
- Reduced cambering and wedge in the roughing stand (in combination with adequate hydraulic sideguides)

LAMINAR STRIP COOLING SYSTEMS (10)
Benefits:
- Improved coiling temperature tolerances
- Extension of the product spectrum (e.g. dual-phase steels)

CVC AND BENDING SYSTEMS (64/102)
Benefits:
- Improved strip profile, flatness and rolling stability
- Extension of the product spectrum
- Cut in rolling costs through longer rolling schedules
- Greater flexibility in production planning

COILER SYSTEMS (26/19)
Benefits:
- Extension of the product spectrum (e.g. higher-strength steels)
- Improved coiling quality
- Meeting of specific requirements (e.g. coiling of very thin or very thick, high-strength strips)
- Increased production
"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."