HIGH-TECH TANDEM COLD MILLS
Cold rolling technology for all requirements
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The X-roll® brand characterizes the product family of the Hot Rolling Mills and Cold Rolling Mills Division. It symbolizes plants and technical equipment for the economical and flexible production of hot and cold strip.

PROVEN ACTUATORS
for influencing the roll gap

The increase in demand in the automobile industry for high-quality cold-rolled strip has triggered a high rate of innovation and development in the recent past. Consequently, more than half of the steel grades used in automobile construction have been further developed or modified. These new materials, such as dual-phase, IF and TRIP steels, require new and optimized technologies for cold rolling.

According to this development, our plants allow a considerable expansion of the setting range for influencing the roll gap. For this purpose, we have further developed our proven actuators CVC®, EDC®, and ESS. CVC® is used for continuous crown control (Continuously Variable Crown), EDC® controls the edge drop (Edge Drop Control) and ESS is an Enhanced Shifting System for the rolls.

Further support is provided by our process model T-roll®. For optimizing the roll gap lubrication (tribology), exact preliminary calculations are possible with regard to temperature, rolling force, lubrication behavior and surface roughness.

We offer our customers state-of-the-art plant technology for cost-efficient production of high-quality rolling products. The term "high-tech rolling" includes all cold rolling technologies where there is a good balance between the technical and economic advantages. The high development status of our cold rolling mills is only possible because of the close cooperation and partnership with our customers.

For the benefit of our customers, we continuously develop new concepts and future-oriented technologies on the basis of tried and tested solutions and methods. Thanks to our extensive technological know-how, we are able to meet the growing requirements of the international market.

FAITH in our plant technology

The great number of plants built by us, especially for strips of great width, reflects the faith that our customers worldwide have in our proven plant technology.
CONTINUOUS TANDEM COLD MILL for fine strip of carbon steel and stainless steel grades

In the first construction stage, the tandem cold mill produces 2 million tonnes of fine strip made of carbon steel and of stainless steel grades. The capacity can be increased to 4.4 million tonnes of carbon steel in the second construction stage. The rolling width extends to 2,057 mm, in the case of stainless steel to 1,676 mm. The minimum final gauge is currently 0.3 mm. Provision has been made for the option of reducing this value to 0.2 mm in the future.

This is the first plant of its kind worldwide, on which strips of carbon steels and stainless steel grades are rolled. An outstanding feature of the plant is the high standard of quality of the strips produced with variable rolling schedules. Furthermore, the mill stands are fitted with the most advanced equipment for strip gauge and flatness control. At favorable production costs, the plant offers high flexibility in order to meet the fluctuations in demand with regard to materials.

An important highlight is the speed efficiency software of SMS Siemag which ensures optimum process control during continuous operation.

Specially designed emulsion system for the rolling of carbon and stainless steel grades.
**DONGBU STEEL, South Korea**

**FIVE-STAND SIX-HIGH TANDEM COLD MILL with ESS technology for a minimum final thickness of 0.12 mm**

SMS Siemag supplied the main production facilities for the Dongbu, Asan Bay works. These are: a continuous pickling line/tandem cold mill with five mill stands of six-high design, one continuous hot-dip galvanizing line as well as one two-stand DCR cold rolling mill (DCR = Double Cold Reduction).

The combined pickling line/tandem cold mill is a prime example of the newly developed high-tech mills and is designed as endless mill for an annual capacity of 1.34 million tons. It is able to produce cold strip with a minimum thickness of 0.12 mm.

**SPECIAL FEATURES**

- Trouble-free production of small finished-strip dimensions with excellent strip qualities and narrow strip thickness, profile and flatness tolerances, by means of a five-stand six-high rolling mill with rolling speeds up to 1,900 m/min.
- Increased yield by direct coupling of the pickling line and the tandem cold mill
- Easy transfer of the finished strip by means of a carrousel-type reel; coil weight increased to 45 t by using a butt-welding machine.

With a rolling speed of up to 1,900 m/min and a minimum strip thickness of 0.12 mm this rolling mill belongs to the high-tech mills.

**Plant configuration**

- 5 stand tandem cold mill coupled to a continuous pickling line
- stands 1-5 in ESS 6-high design
- continuous exit section with carrousel reel
**COLD STRIP OF THE HIGHEST QUALITY**

With the construction of one of the world’s most sophisticated and productive tandem cold mills, ThyssenKrupp Steel in Duisburg was able to conclude an investment program which sets high standards.

Under our leadership, a five-stand high-tech tandem cold mill was set up which is unique in terms of forming capacity and tolerances:

- Possibility of rolling high and higher-strength grades in large strip widths and low gauges.
- Implementation of the narrowest thickness tolerances over the strip length
- Clear improvement in flatness
- Reduction of surface defects
- Reduction of the edge drop in the strip edge area
- Improvement of yield

All five stands are of CVC® six-high design and have the following features:

- Axial shifting of the intermediate rolls
- EDC® at mill stands 1 to 4 with level 2 models based on Plug & Work
- AIO design (All-In-One) of the piping, the side walls and the mill stand platform in modular construction
- Simultaneous work-roll change at all mill stands in less than eight minutes

ThyssenKrupp Steel - comments about main features of the AIO piping: “Concentration of valve stands at the mill stand platform with short erection times, good accessibility for maintenance, no leakages into strip area, optimized pipe feeding to the consumers, excellent protection against damages.”

**FIVE-STAND CVC® TANDEM COLD MILL COMBINED WITH A PICKLING LINE**

**Year of commissioning:** 2001

**Annual production**
- Finished strip: 2,100,000 t

**Material grades**
- Low-alloyed carbon steels
- High-strength low-alloyed steels
- Multi-phase steels

**Strip data, entry section**
- Width: 1,000 to 2,040 mm
- Thickness: 1.5 to 6.5 mm
- Coil outer diameter: 1,000 to 2,650 mm
- Max. coil weight: 36,000 kg
- Coil inner diameter: 610 mm

**Strip data, exit section**
- Width: 1,000 to 2,040 mm
- Thickness: 0.3 to 3.0 mm
- Coil outer diameter: 1,000 to 2,650 mm
- Max. coil weight: 50,000 kg
- Coil inner diameter: 610 mm

**Plant configuration**
- Five-stand tandem cold mill coupled to a continuous pickling line
- All mill stands of CVC® plus six-high design with EDC®
- Continuous exit section with two coilers
- Inline strip inspection station
HYUNDAI HYSCO, South Korea

PICKLING LINE/TANDEM COLD MILL (PL-TCM) for sheet and low-alloyed steels

Hyundai Hysco has been operating a combined pickling line/tandem cold mill which was built by us in the former works of Hanbo Steel in Asan Bay, South Korea. As leader of a European consortium, we erected this line ready for operation in 1997. As a result of the economic crisis in Asia, however, this plant had not been commissioned at that time. At the beginning of 2006, the plant was overhauled and commissioned by us in co-operation with Hyundai Hysco.

Nowadays, the plant has an annual production capacity of 1.55 million t of steel strip. The range of grades comprises CQ, DQ, DDQ, EDDQ, HSS and HSLA steels. The minimum strip thickness is 0.25 mm, the maximum strip width is 1,890 mm. The mill is equipped with four four-high stands and one six-high stand, each containing CVC® plus.

The mills stands are provided with width and thickness control systems corresponding to the state of the art. Another unique feature of the plant is the inline strip inspection, facilitating direct quality control of the rolled stock. The pickling line which is installed upstream is equipped with our approved turbulence-pickling technology, permitting an optimum control of the hydrochloric-acid concentration and of the strip temperature during strip treatment.

After 9 years of shut-down: Start of production with the overall-revamped PL-TCM Hyundai Hysco
**ArcelorMittal VEGA, Brazil**

**A NEW PRODUCER OF COLD STRIP**

We have built a new rolling mill on a turnkey basis for VEGA do Sul S.A., a company managed by the Arcelor Group, in São Francisco do Sul in the South of Brazil. VEGA is located near the Atlantic harbor of São Francisco. The VEGA complex has been in operation since October 2003. Since 2008 it operates under the name of ArcelorMittal Vega. The cold rolling mill, we erected as general contractor, produces sophisticated, high-quality products.

In addition the drive power in the first millstand was increased and the media systems were modified. By these measures the annual capacity of the mill was boosted up to 1.4 m tonnes.

Because of the excellent establishment and market position, ArcelorMittal is planning a further increase of the cold rolling capacities up to about 2.1 m t/a for the AM Vega facility.

In the first construction stage ArcelorMittal Vega produced 800,000 t/year of cold strip. In 2009 SMS Siemag was contracted with the extension of the pickling line/tandem cold mill. The intention behind was a changeover to fully continuous operation. For this purpose a drum shear with corresponding pinch roll units, a second tension reel as well as the needed stripleading- and transportation facilities, including the second coil transportation system, was installed in the exit section.

**FOUR-STAND CVC® TANDEM COLD MILL COMBINED WITH A PICKLING LINE**

<table>
<thead>
<tr>
<th>Year of commissioning</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual production</td>
<td></td>
</tr>
<tr>
<td>Finished strip Phase 1</td>
<td>880,000 t</td>
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<tr>
<td>Phase 2</td>
<td>1,400,000 t</td>
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<tr>
<td>Material grades</td>
<td></td>
</tr>
<tr>
<td>Low-alloyed carbon steels</td>
<td></td>
</tr>
<tr>
<td>High-strength low-alloyed steels</td>
<td></td>
</tr>
</tbody>
</table>

**Strip data, entry section**

- Width: 750 to 1,875 mm
- Thickness: 1.2 to 4.8 mm
- Coil outer diameter: 1,200 to 2,100 mm
- Max. coil weight: 40,000 kg
- Coil inner diameter: 610 mm

**Strip data, exit section**

- Width: 750 to 1,875 mm
- Thickness: 0.4 to 2.0 mm
- Coil outer diameter: 1,200 to 2,100 mm
- Max. coil weight: 40,000 kg
- Coil inner diameter: 610 mm

**Plant configuration**

- Four-stand tandem cold mill coupled to a continuous pickling line
- All mill stands in CVC® plus four-high design
- Exit section with one coiler and offline strip inspection station
- Extension to continuous exit with double tension reels
HAN DAN IRON & STEEL, China

PICKLING LINE/TANDEM COLD MILL (PL-TCM) for 1.4 million t cold strip

In September 2005 the first cold rolling mill was put into permanent operation at Handan Iron & Steel Co. Ltd., Hebei Province, China. We had received the order for the combined pickling line/tandem cold mill and a skin-pass mill in October 2002 in our capacity as consortium leader.

The rolling mill is designed for an annual production of 1.4 million t of cold strip of the most varying material grades. In addition to low-carbon steels (CQ, DQ and DDQ), high-strength steels (HSLA) and silicon steels can also be processed into finished products.

The plant consists of a turbulence pickling line of the latest generation and a five-stand tandem cold mill with CVC® plus technology. Also included in the scope of supply are the single-stand high-performance four-high skin-pass mill with the double expanding head pay-off reel group for shortest coil sequence times, a skinpass mill as well as hydraulic systems and the coil conveying system.

A two-strand CSP® facility supplies the hot strip for the new cold rolling mill. The numerous actuators at the five-stand tandem cold mill as well as the axially shiftable intermediate rolls for CVC® plus control and positive and negative work-roll and intermediate-roll bending make it possible for the owner to attain a high degree of flexibility and to manufacture products of the best quality. Handan thus succeeds in meeting the continuously growing market demands for top cold-strip quality. This combined pickling line/tandem cold mill is one of the most modern facilities which we have completed in China in recent times.
Acceptance of the COUPLLED PICKLING LINE/TANDEM COLD MILL after less than 26 months

On 25 August 2005, the first cold rolling mill was put into permanent operation at Baotou Iron & Steel Co. Ltd., Inner Mongolia, China. The plant consists of a turbulence pickling line of the latest generation coupled with a five-stand tandem cold mill with CVC® plus technology. The cold rolling mill is designed for an annual capacity of 1.4 million t of high-grade steel strips.

It is able to produce strips with minimum thicknesses of 0.25 up to 3.0 mm and widths up to 1,540 mm. The hot strip for the new cold rolling mill is produced by a CSP® facility, which was also supplied by us and which was already commissioned in August 2001.

All guarantee values for thickness tolerances, flatness and off-gauge lengths were already fulfilled during the production tests on the tandem cold mill at the beginning of August 2005 and the guaranteed production capacity was considerably exceeded.

With this investment, Baotou had expanded its spectrum of products. By means of the continuous process chain established here - from the CSP® plant to the surface-finishing facilities with innovative technologies from SMS Siemag - Baotou is able to maintain its market position in the face of the increasing product requirements of the future.

Extremely short project handling time: rolling of the first cold strip after just 21 months.

FIVE-STAND CVC® TANDEM COLD MILL COMBINED WITH PICKLING LINE

Year of commissioning 2005

Annual production Finished strip 1,432,000 t

Material grades Low-alloyed carbon steels
High-strength low-alloyed steels

Strip data, entry section
Width 980 to 1,580 mm
Thickness 1.8 to 6.0 mm
Coil outer diameter 1,100 to 1,950 mm
Max. coil weight 28,000 kg
Coil inner diameter 762 mm

Strip data, exit section
Width 960 to 1,540 mm
Thickness 0.25 to 3.0 mm
Coil outer diameter 1,100 to 1,900 mm
Max. coil weight 28,000 kg
Coil inner diameter 610 mm

Plant configuration
- Five-stand tandem cold mill coupled to a continuous pickling line
- All mill stands in CVC® plus six-high design, prepared for subsequent installation of EDC®
- Continuous exit section with carousel reel
- Offline strip inspection station
Expansion of the new COLD ROLLING COMPLEX

In order to expand its cold strip production, Wuhan Iron & Steel Group Corporation (Wisco) in Wuhan, Hubei Province, China, placed an order with us in September 2003 for the supply of a pickling line combined with a tandem cold mill.

The plants are part of a new cold rolling complex which is arranged downstream of hot strip mill No. 2 also built by us. The first strip was produced in 2005. The new complex is designed for the production of cold-rolled and refined strips of the highest quality for the automotive industry, for applications in the electrical engineering sector and for the construction industry.

With a rated annual capacity of 2.3 million t, the pickling line/tandem cold mill ranks among the most powerful plants of its type worldwide. Strips widths of 800 to 2,080 mm are produced with the best surface quality and best flatness.

The first tandem cold mill in China for the manufacturing of automotive sheets up to 2,080 mm wide.

FIVE-STAND CVC® TANDEM COLD MILL COMBINED WITH A PICKLING LINE

<table>
<thead>
<tr>
<th>Year of commissioning</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual production</td>
<td>2,300,000 t</td>
</tr>
<tr>
<td>Material grades</td>
<td>Low-alloyed carbon steels, High-strength low-alloyed steels, Multi-phase steels</td>
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</tbody>
</table>

Strip data, entry section

<table>
<thead>
<tr>
<th>Width</th>
<th>Thickness</th>
<th>Coil outer diameter</th>
<th>Max. coil weight</th>
<th>Coil inner diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 to 2,080 mm</td>
<td>1.5 to 6.0 mm</td>
<td>1,000 to 2,150 mm</td>
<td>38,000 kg</td>
<td>762 mm</td>
</tr>
</tbody>
</table>

Strip data, exit section

<table>
<thead>
<tr>
<th>Width</th>
<th>Thickness</th>
<th>Coil outer diameter</th>
<th>Max. coil weight</th>
<th>Coil inner diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 to 2,080 mm</td>
<td>0.3 to 2.5 mm</td>
<td>1,000 to 2,150 mm</td>
<td>38,000 kg</td>
<td>610 mm</td>
</tr>
</tbody>
</table>

Plant configuration

- Five-stand tandem cold mill combined with a continuous pickling line
- All mill stands in CVC® plus six-high design with EDC®
- Continuous exit section with carousel reel
- Offline strip inspection station
SEVERSTAL COLUMBUS, USA

COLD ROLLING MILL with five-stand pickling line/tandem cold mill (PL-TCM)

Severstal Columbus (formerly SevenCorr), USA, had placed a major order with us in the autumn of 2005 for the supply of all production facilities for an integrated works, ranging from steel production to hot strip, from cold rolling to strip refining. The cold rolling mill consisted of the combined five-stand pickling line/tandem cold mill as well as an offline skinpass mill and a hot-dip galvanizing line with an inline skinpass mill.

In the first expansion stage, the rolling mill was designed for an annual capacity of around 1.2 million t of cold strip. Of this amount, around 0.8 million t were processed further in downstream lines in the cold rolling mill. In the second construction stage, this capacity was increased to around 1.8 million t of cold strip. The tandem cold mill was prepared from the very beginning for the expansion. The maximum strip width was 1,830 mm, the minimum thickness 0.3 mm.

The pickling line/tandem cold mill is equipped with our proven turbulence pickling technology and five four-high stands. The plant has an inline inspection line to enable the final product to be controlled during the production process. The inspection facilities of the “Rotary Inspect” design make it possible to inspect both sides of the strip easily and in a reliable manner. The investment costs are low as no additional equipment is required.

The inline inspection line with the strip turnover device “Rotary Inspect” in the exit section of the tandem cold mill enables quality control during the production process.

FIVE-STAND CVC® TANDEM COLD MILL COMBINED WITH PICKLING LINE

Year of commissioning 2007

Annual production
Finished strip
Phase 1 1,252,000 t
Phase 2 1,814,000 t

Material grades
Low-alloyed carbon steels
High-strength low-alloyed steels
Multi-phase steels

Strip data, entry section
Width 914 to 1,830 mm
Thickness 1.4 to 5.0 mm
Coil outer diameter 2,100 mm
Max. coil weight 40,000 kg
Coil inner diameter 760 mm

Strip data, exit section
Width 914 to 1,830 mm
Thickness 0.27 to 1.4 mm
Coil outer diameter 2,000 mm
Max. coil weight 40,000 kg
Coil inner diameter 610 mm

Plant configuration
- Five-stand tandem cold mill coupled to a continuous pickling line
- All mill stands in CVC® plus four-high design
- Continuous exit section with two coilers
- Inline strip inspection station; rotary inspect
BAOSHAN IRON & STEEL, China

COMBINED PICKLING LINE/TANDEM COLD MILL for the cold rolling complex No. 5

In autumn 2005 Baoshan Iron & Steel Co. Ltd., based in the Chinese province of Shanghai, awarded us a contract for the supply of the combined pickling line/tandem cold mill. The new plant was ready for operation as early as three months before the agreed date. It has enabled Baosteel to considerably increase its cold strip production. Commissioning of the five-stand combined pickling line/tandem cold mill took place in March 2008. This is already the third pickling line/tandem cold mill which we have supplied to this customer.

The plant is part of the new cold rolling complex No. 5. Its range of products includes cold-rolled and refined strip of the highest quality for the automotive industry, for applications in the electrical engineering sector and for the construction industry. The annual capacity is approx. 1.7 million t of cold strip.

All five stands of the tandem cold mill have the CVC® plus technology. To facilitate the installation and maintenance of the utilities supply systems, the modular components have been put together on one platform. Best possible strip flatness is achieved through a multi-zone cooling system in the last stand, while the patented dry strip system in the exit section ensures clean and drip-free strip surfaces.

The strip is sealed off from the emulsion by controlled air flow without any mechanical contact. The tandem cold mill operates with a carousel reel for short coil sequence times.

Important for the automotive customers of Baosteel: A strip inspection line guarantees continuous quality control, thus fulfilling the special requirements with regard to automotive sheets.

High strip quality for automotive sheets through numerous high-tech components.

FIVE-STAND CVC® TANDEM COLD MILL COMBINED WITH A PICKLING LINE

Year of commissioning 2008

Annual production
Finished strip 1,737,000 t

Material grades
Low-alloyed carbon steels
Multi-phase steels

Strip data, entry section
Width 700 to 1,630 mm
Thickness 1.8 to 6.0 mm
Coil outer diameter 2,150 to 900 mm
Max. coil weight 34,500 kg
Coil inner diameter 760 mm

Strip data, exit section
Width 700 to 1,630 mm
Soft grades 0.25 to 2.3 mm
Hard grades 0.35 to 3.0 mm
Coil outer diameter 900 to 2,100 mm
Max. coil weight 34,500 kg
Coil inner diameter 508 / 610 mm

Plant configuration
- Five-stand tandem cold mill coupled to a continuous pickling line
- All mill stands in CVC® plus six-high design, prepared for subsequent installation of EDC®
- Continuous exit section with carousel reel
- Offline strip inspection station
The Tianjin Tiantie Metallurgical Group Co. Ltd., was founded in 1995. The firm evolved from the Tianjin Steel Factory, which has been in existence since 1969. In spring 2006, Tiantie awarded us a contract for the supply of a combined pickling line/tandem cold mill.

The plant consists of a turbulence pickling line of the latest generation combined with a five-stand tandem cold mill with six-high stands in CVC® plus technology as well as numerous other renowned high-tech modules from SMS Siemag.

Our scope of supply included the conceptual design as well as the supply of the mechanical equipment for the overall plant, manufacturing supervision of local manufacture as well as supervision of erection and commissioning and the co-ordination of all supplies and services of the consortium partners.

The annual production is 1.6 million t of strip made of low-carbon steels, IF steels and high-strength steels. The strip widths are between 700 and 1,600 mm and the final thicknesses between 0.25 and 2.0 mm.

In order to be able to satisfy future market requirements, the plant can be additionally equipped with an EDC® system for strip-edge-oriented mode of operation, if required. Production was started in May 2008. In addition to the main order, Tiantie awarded us the contract for the supply of an offline skin-pass mill in April 2008.
COMBINED PICKLING LINE/TANDEM COLD MILL for 1.8 million t of cold strip

In June 2005 the Shougang Group in West Beijing, China, placed an order with us as consortium leader for the supply of a combined high-performance pickling line/tandem cold mill. The annual capacity of the plant is 1.8 million t of cold strip.

Strips of high quality and strength are manufactured from DP, BH and TRIP steels, for example for the production of high-grade automotive outer body parts. The pickling line/tandem cold mill was commissioned in November 2007.

The five-stand tandem cold rolling mill has six-high mill stands and is equipped with state-of-the-art technology. It is also provided with our CVC® plus system and our Edge Drop Control system (EDC®).

The strips are wound with a carrousel reel. Highly powerful suction and filter systems ensure environmentally friendly operation.

The turbulence pickling line of the latest generation is also equipped with our tried and tested stretch-bending levelers and an ASC trimming shear. With this investment, Shougang intends to expand the product range and increase the value added. This is a sure sign of progress, consolidating Shougang’s market position in view of the growing future requirements for various products.

Shougang produces steel strips of top quality for automotive applications at Beijing-Shungi.
From Posco we have received an order for the supply of a fully continuous tandem cold mill for stainless steel. The mill is intended for the production of cold strip of the grades ASTM 200, 300 and 400. It is designed for an annual production capacity of 500,000 t. The five-stand high-performance plant will be the first fully continuous tandem cold mill worldwide to be exclusively used for rolling stainless steel strip. At the end of 2009 the plant went into operation.

In the mill, pickled hot strip with entry thicknesses between 1.8 and 4.0 mm is rolled down to finished cold strip with thicknesses ranging from 0.4 to 2.0 mm. The strip width is 600 to 1,350 mm, the maximum coil weight is 40 t.

**HIGH PASS REDUCTIONS.**

The core components of the high-tech tandem mill are the four roll stands in 18-HS design. Owing to the small work-roll diameters, the mill is able to achieve extremely high pass reductions which guarantees highly economical production of 500,000 t of special-steel strip per year. The slim work rolls are laterally supported to accommodate the high horizontal forces. Drive is accomplished via the axially shiftable intermediate rolls.

**OPTIMIZED THROUGH T-ROLL®.**

We used our TRoll® process model to design the plant and ascertain the optimal temperature control of the rolling stock. In this way, suitable cooling and lubricating strategies could be determined ensuring maximum pass reductions at stable roll-gap conditions and limitation of the coiling temperature to maximum 100 °C.

**ENTRY- AND EXIT-END EQUIPMENT.**

The entry area of the continuous tandem mill comprises a payoff reel, a welding machine and a horizontal strip accumulator. Our supply package for the exit section included two tension reels with continuous paper feed, a drum-type shear and our inline “Rotary Inspect” strip inspection facility. The carousel-type paper dispenser safeguards continuous operation including automatic paper-coil changing.

To ensure optimum strip control, the exit section is provided with a patented “Rotary Inspect” inspection line.

**ECONOMICAL PRODUCTION OF AN ANNUAL PRODUCTION VOLUME OF 500,000 T IN A FULLY CONTINUOUS MILL.**

**CONTINUOUS TANDEM COLD MILL FOR STAINLESS STEEL**

- **Year of commissioning:** 2009
- **Annual production:** 500,000 t/year
- **Material grades:** Stainless-steel hot and cold strip
- **Strip data, entry section:**
  - Width: 600 to 1,350 mm
  - Thickness: max. 5.0 mm
  - Coil weight: max. 40,000 kg
- **Strip data, exit section:**
  - Width: 600 to 1,350 mm
  - Thickness: 0.4 to 2.0 mm
  - Coil weight: max. 40,000 kg
- **Plant configuration:**
  - 5 stand tandem cold mill in 18 HS design
  - Mill stands 1 to 4 ZR613A-54”
  - Mill stand 5 two-high
  - Inline strip inspection station “Rotary Inspect”
  - Continuous supply of paper in the exit section
  - Continuous exit section with two coilers
HANDAN IRON & STEEL, China

PICKLING LINE/TANDEM COLD MILL for 2.1 million t of cold strip

In January 2008, the Handan Iron & Steel Group Han-Bao Company Ltd placed an order with us as consortium leader for the supply of a combined pickling line/tandem cold mill. The Handan & Baosteel joint venture is setting up this new cold rolling mill complex on the premises of Handan.

The rolling mill is designed for an annual production of 2.1 million t of cold strip of the most varying material grades. In addition to low-carbon steels (CQ, DQ and DDQ), high-strength steels (HSS4) can also be processed into finished products.

The plant consists of a turbulence pickling line of the latest generation and a five-stand tandem cold mill with CVC® plus six-high technology. The numerous actuators at the five-stand tandem cold mill as well as the axially shiftable intermediate rolls for CVC® plus control and positive and negative work-roll and intermediate-roll bending make it possible for the owner to attain a high degree of flexibility and to manufacture products of the best quality.

With the pickling line/tandem cold mill supplied by us, Handan has succeeded in meeting the continuously growing market demands for top-quality cold strip. This combined pickling line/tandem cold mill is one of the most modern facilities which is being built in China at present.

FIVE-STAND CVC®-TANDEM COLD MILL COMBINED WITH A PICKLING LINE

- Year of commissioning 2010
- Annual production Finished strip 2,150,000 t
- Material grades Low-alloyed carbon steels High-strength steels
- Strip data, entry section Width 930 to 2,080 mm Thickness 1.8 to 6.0 mm Coil outer diameter 1,100 to 2,150 mm Max. coil weight 40,000 kg Coil inner diameter 762 mm
- Strip data, exit section Width 930 to 2,080 mm Thickness Low-alloyed carbon steels 0.30 to 2.50 mm High-strength steels 0.40 to 2.50 mm Coil outer diameter 1,100 to 2,150 mm Max. coil weight 40,000 kg Coil inner diameter 610 mm
- Plant configuration
  - Five-stand tandem cold mill coupled to a continuous pickling line
  - All mill stands in CVC® plus six-high design with ESS, prepared for subsequent installation of an edge-drop control system EDC®
  - Continuous exit section with carrousel reel
  - Offline strip inspection station
SHOUGANG JINGTANG, China

Another PICKLING LINE/TANDEM COLD MILL for the production of automotive sheets

In April 2008, Shougang Jingtang United Iron & Steel Co., Ltd., Caofeidian, Hebei Province, China, placed an order with SMS Siemag AG as consortium leader for the supply of a new pickling line/tandem cold mill for an annual production of approx. 2.2 million t of cold strip. One important feature is the production of high-quality grades for the automotive industry.

Our scope of supply for this cold rolling mill with a combined pickling line/tandem cold mill comprises the design, supply and the supervision of commissioning of the plant.

- Turbulence pickling line of the latest generation with stretch-bending leveler, ASC trimming shear and coupling section.
- Five-stand tandem cold mill with six-high stands with CVC® plus and ESS technology and AIO design; prepared for subsequent installation of an EDC® edge-drop compensation system; carrousel reel.
- Modern strip inspection line, tailor-made for the particular requirements of continuous quality assurance for automotive sheets.
- Coil conveyor systems, exhaust systems, utility systems, coil banding machine.

Start-up of production was at the end of 2010. Thanks to this investment and the technologies used by SMS Siemag, Shougang Jingtang has been able to expand its product range to include the products and grades required by the market.
ThyssenKrupp Steel, USA

NEW WORKS COMPLEX FOR HOT AND COLD STRIP

ThyssenKrupp Steel (TKS) regards the setup of a new works complex for hot and cold strip in the US federal state of Alabama as a milestone in the development of the American market. For this purpose, TKS placed an order with us for the supply of the hot strip mill, a pickling line/tandem cold mill and numerous process lines for strip refining.

With an annual capacity of 2.5 million tons, the combined pickling line/tandem cold mill (PL-TCM) currently boasts the world’s largest production in this field. The coils arriving from the hot coil store pass through a double payoff reel group in the entry section of the continuous pickling line/tandem cold mill.

The pickled strip is then reduced on the coupled five-stand four-high tandem cold mill to final gauges of 0.3 to 3 mm. The tandem cold mill is equipped with the CVC® plus technology and a multi-zone cooling and DS system in the last stand. In the exit section, two coilers wind up the strips. Quality control can take place during the actual production process thanks to the inline inspection line “Rotary Inspect”.

Furthermore, we supply auxiliary facilities such as coil conveying equipment, the hydraulic systems, the emulsion systems and various exhaust systems for maintaining high environmental standards.

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FIVE-STAND CVC® TANDEM COLD MILL COMBINED WITH A PICKLING LINE

Year of commissioning: 2010

Annual production: 2,500,000 t

Material grades:
- Low-alloyed carbon steels
- High-strength low-alloyed steels

Strip data, entry section:
- Width: 800 to 1,870 mm
- Thickness: 1.50 to 6.00 mm
- Coil outer diameter: 1,100 to 2,400 mm
- Max. coil weight: 36,000 kg
- Coil inner diameter: 762 mm

Strip data, exit section:
- Width: 800 to 1,870 mm
- Thickness: 0.30 to 3.00 mm
- Coil outer diameter: 1,000 to 2,300 mm
- Max. coil weight: 36,000 kg
- Coil inner diameter: 610 mm

Plant configuration:
- Five-stand tandem cold mill combined with a continuous pickling line
- All mill stands in CVC® plus four-high design
- Continuous exit section with two coilers
- “Rotary Inspect” inline strip inspection station

New production facilities for hot and cold strip in Alabama, USA.
MMK, Russia

**COLD STRIP COMPLEX WITH COMBINED PICKLING LINE/TANDEM COLD MILL**

The Magnitogorsk Metallurgical Combine (MMK) in Russia has ordered a cold strip complex with a combined pickling line/tandem cold mill and facilities for strip refining. This new order includes the supply of all mechanical components and the X-Pact® electrical and automation system. The plants are scheduled to go into operation in 2010.

MMK is one of Russia’s leading steel producers and, by means of this investment, is expanding its production of cold-rolled and galvanized strip to a high standard of quality. This strip is intended above all for the manufacture of automotive sheets and motor-car internal parts as well as for the domestic appliance and construction industries.

The cold-rolling stage consists of a combined picking line/tandem cold mill with an annual capacity of approx. 2.1 million tons. It is equipped with the proven turbulence pickling line technology and possesses five four-high stands. The plant is the world’s most powerful combined pickling line/tandem cold mill, with its high drive power ratings of 8 MW and a roll force of 35 MN per stand.

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<table>
<thead>
<tr>
<th>Year of commissioning</th>
<th>2011</th>
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<tbody>
<tr>
<td>Annual production</td>
<td>2,100,000 t</td>
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<tr>
<td>Material grades</td>
<td>Low-alloyed carbon steels, High-strength low-alloyed steels, Multi-phase steels</td>
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<tr>
<td>Strip data, entry section</td>
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<tr>
<td>Width</td>
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<tr>
<td>Thickness</td>
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<td>Coil outer diameter</td>
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<td>Max. coil weight</td>
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<td>Coil inner diameter</td>
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<tr>
<td>Strip data, exit section</td>
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<tr>
<td>Width</td>
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<tr>
<td>Thickness</td>
<td>0.28 to 3.0 mm</td>
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<tr>
<td>Coil outer diameter</td>
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<td>Max. coil weight</td>
<td>43,500 kg</td>
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<td>Coil inner diameter</td>
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<tr>
<td>Plant configuration</td>
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<tr>
<td>Five-stand tandem cold mill combined with a continuous pickling line</td>
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<tr>
<td>All mill stands in CVC® plus four-high design</td>
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<tr>
<td>SMS Siemag shapemeter rolls</td>
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<tr>
<td>Continuous exit section with two coilers</td>
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<tr>
<td>&quot;Rotary Inspect&quot; inline strip inspection station</td>
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</tbody>
</table>
JSW STEEL LIMITED, India

PICKLING LINE/TANDEM COLD MILL for 2.3 million t cold strip each year in widths up to 1,890 mm.

At the beginning of February 2011 JSW Steel Limited issued an order to us for the supply of a pickling line/tandem cold mill, to be erected at the Toranagalu Vidyamager (Bellary) location in India. The customer was impressed above all by the low drive costs and maintenance costs of our plant concept.

On the new pickling line/tandem cold mill, JSW Steel Limited will be producing strips in high-quality steel grades as from 2013 and supplying these to the automotive industry.

The comprehensive supply scope includes the entry section, equipped with two payoff reel groups and with a SMS Siemag laser welder and a tension leveller. The turbulence-pickling technology allows optimum descaling with low consumption of energy and acid as well as reduced maintenance and operating costs. In addition, an integrated trimming shear sets the desired strip width and straightens the strip edges. Altogether, three horizontal strip accumulators are integrated into the line and ensure continuous strip travel.

All five millstands of the tandem cold mill are of six-high design and are equipped with the new combined CVC® plus / ESS technology (Enhanced Shifting System). Furthermore, the millstands have been prepared for Edge Drop Control (EDC®) to be used later on. EDC® can be retrofitted and ensures a constant strip thickness as far as the strip edges, enabling the side trimmings to be minimized and the plant yield enhanced. Perfect flatness makes multi-zone cooling possible in the final millstand. For strip drying a Dry Strip System is installed.

The carousel reel present in the exit section of the tandem cold mill allows continuous coiling of the strip, which has been rolled down to a minimum final gauge of 0.3 mm.

We also supply JSW Steel with the auxiliary facilities, comprising coil conveyor system, coil banding machine, exhaust systems, utility system and a separate inspection line for monitoring the strip quality. The carousel reel has been “set lower”, which provides the customer with the option of installing an inline inspection line at a later point in the future.

The five-stand tandem cold mill coupled to a continuous pickling line.

Coupled pickling line/ tandem cold mill.
REFERENCE PLANTS SINCE 1976

<table>
<thead>
<tr>
<th>CUSTOMER</th>
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<th>MATERIAL</th>
<th>ANNUAL CAPACITY</th>
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<td>Carbon steel</td>
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<td>Carbon steel</td>
<td>1,210,000 t</td>
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<tr>
<td>National Steel, Philippines</td>
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<td>Posco, South Korea</td>
<td>5-stand PL-TCM</td>
<td>Carbon steel</td>
<td>1,000,000 t</td>
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<td>Armco, USA</td>
<td>3-stand TCM</td>
<td>Stainless steel</td>
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<td>Posco Industries, USA</td>
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<td>Carbon steel</td>
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<td>Usiminas, Brazil</td>
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<td>AK Steel, USA</td>
<td>5-stand C-TCM</td>
<td>Carbon steel/Stainless steel</td>
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<td>Carbon steel</td>
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<td>Carbon steel</td>
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<td>Hyundai Hysico, South Korea</td>
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<td>Vega do Sul, Brazil</td>
<td>4-stand PL-TCM</td>
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<td>Wisco, China</td>
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<td>Shougang Group, China</td>
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<td>Posco, South Korea</td>
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<td>JSW Steel, India</td>
<td>5-stand PL-TCM</td>
<td>Carbon steel</td>
<td>2,300,000 t</td>
</tr>
</tbody>
</table>

TCM = Tandem Cold Mill    C-TCM = Continuous Tandem Cold Mill    PL-TCM = Pickling Line - Tandem Cold Mill
"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."