

High-Tech Tandem Cold Mills

Cold rolling technology for all requirements



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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.

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.





CVC®, CVC®plus, EDC® and T-roll® are registered trademarks of SMS group.

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®plus, 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.

Our range of products

We offer the best plant engineering and the most sophisticated technology. Our rolling mills work in a cost-efficient manner with low production and operating costs. On request you can receive all-inclusive supply packages, that is to say, plant engineering, process engineering, automation, electrical engineering and technological competence, comprising installation, commissioning and training, from one single source.



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Our latest developments keep you at the cutting edge

Sieflex®-HT gear type drive spindle

Transmission of high rolling torques even at small work roll diameters



Drive train with Sieflex®-HT gear type drive spindle for a cold rolling mill with work roll drive.

Technical feature

- Improved tooth rim design
- Material of higher wear resistance
- Enlargement of alignment range up to 3.5 degree

Benefits

- Smaller work rolls
- Lower rolling force
- Reduced operating costs
- More compactly designed new mills
- Increased capability of existing plants
- Optimal for product mix including high and ultra-high strength grades

Emulsion Compact Unit (ECU)

Emulsion plant in very compact design with only small space requirements



ECU-concept for a pickling line tandem cold mill with separate emulsion plants for rolling stands 1-4 and 5.

Technical feature

- Multi-level installation
- Reuse of heat from the rolling process
- Reduced piping

Benefits

- Considerably reduced space requirements (up to 40%)
- Reduced energy consumption
- Lower investment level

Total Roll Gap Control (TRC®)

Threading in and out assistant, in order to increase yield



Integrated in the level 2 automation, for the first time TRC® was installed for the first time in the course of the modernization of a tandem cold mill

Technical feature

- Optimal roll gap adjustment during threading in and out by consideration of additional information about strip head and tail end
- Yield increase of batch mills

Benefits

- Increase of process stability
- Increase of production up to 20 %
- Up to 50 % reduced off-gauge length

CVC®plus M 18/4 Multipurpose Mill

Rolling of soft and high strength steels including stainless steel in one and the same stand



Changeable roll sets of the multipurpose mill.

Technical feature

- Changeable CVC®plus Quarto- and 18-HS roll sets
- Change of the complete roll cassettes
- Change of operation mode within only 7 minutes during a regular roll change

Benefits

- Flexible rolling of a very large product range within one and the same rolling mill
- High pass reductions
- Retrofitting in existing rolling stands possible
- Efficient production also of smaller batches of soft or high- and ultra-high strength grades
- Enlargement of product range at low investment costs

Tension reel concept

Handling of „Jumbo Coils“ of up to 70 tons weight in order to increase yield



Accurate winding at high strip tension and winding of „jumbo coils“ are no problem for the Twin Reel concept of SMS group.

Technical feature

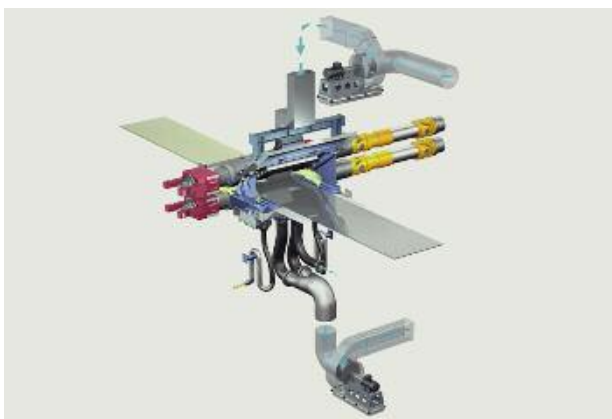
- Compact, strong and accurate: the Twin Reel combines the benefits of double and carousel reel and is „the“ solution for any continuous exit
- Applicable for any material property and strip quality

Benefits

- Right from the first windings, the winding of finished strip at high tension is possible
- Especially beneficial for high strength grades
- Optimized handling of sensitive strip surfaces
- Winding of very heavy coils to increase yield
- Simplified removal and transportation of finished coils with one coil car

DS System

Cost efficient strip blow-off system by reduced compressed air consumption



Exit side installation of blow-off system in the last stand of a cold rolling mill

Technical feature

- Optimal combination of stationary and moveable sealing elements
- Contact- and wearless sealing of the work roll barrel by the COANDA-nozzle
- Targeted and perfectly balanced blow-off and exhaust areas

Benefits

- Reduced noise emission
- 50 % reduced maintenance costs
- More than 60 % reduced energy costs
- 80 % less rejected coils because of emulsion residues on the strip

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.



Entry end to tandem cold mill.

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.



"Creative art" on the foundation of the combined pickling line/tandem cold mill.



View of the tandem cold mill.

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

Five-stand CVC® tandem cold mill combined with a pickling line – Year of commissioning 2006

Annual production

Finished strip 1,550,000 t

Material grades

Low-alloyed carbon steels

High-strength low-alloyed steels

Strip data, entry section

Width 900 to 1,890 mm

Thickness 1.2 to 6.0 mm

Coil outer diameter

2,600 mm

Max. coil weight

44,000 kg

Coil inner diameter

720 mm

Strip data, exit section

Width

900 to 1,890 mm

Thickness

0.25 to 3.2 mm

Coil outer diameter

2,600 mm

Max. coil weight

44,000 kg

Coil inner diameter

610 mm

Plant configuration

- Five-stand tandem cold mill combined with a continuous pickling line
- Stands 1 to 4 in CVC®plus four-high design
- Stand 5 in CVC®plus six-high design
- Continuous exit section with two coilers
- Inline strip inspection station

AK Steel, USA



Continuous tandem cold mill for fine strip of carbon steel and stainless steel grades

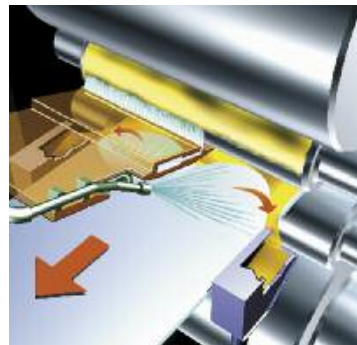
In the first construction stage, the tandem cold mill produces 2 million tonnes of fine strip made of carbon steel and of stainless steel grades. The capacity can be increased to 4,4 million tonnes of carbon steel in the second construction stage. The rolling width extends to 2,057 mm, in the case of 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.

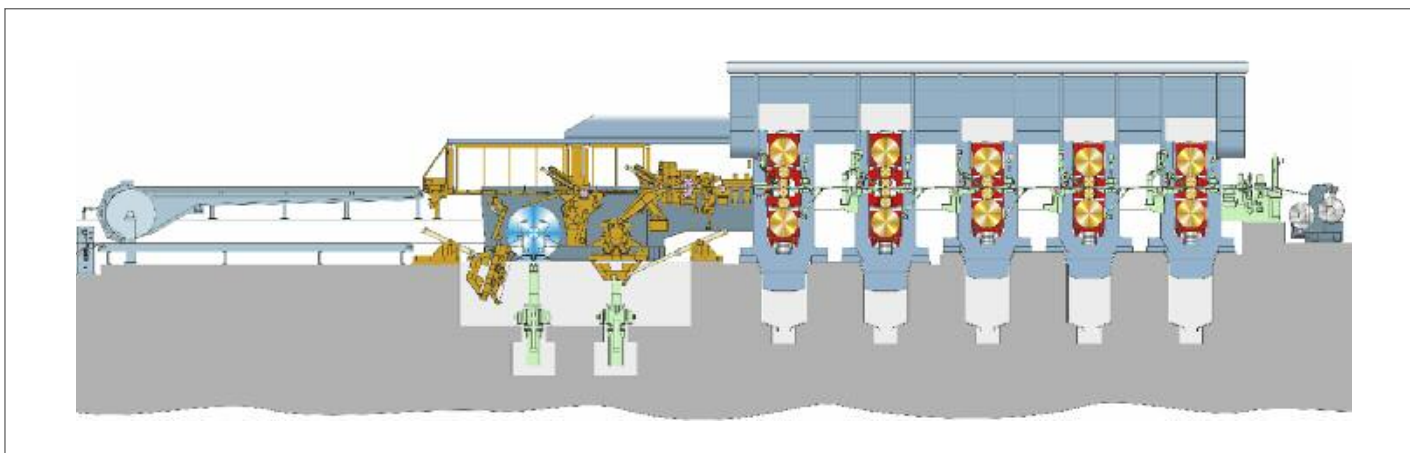
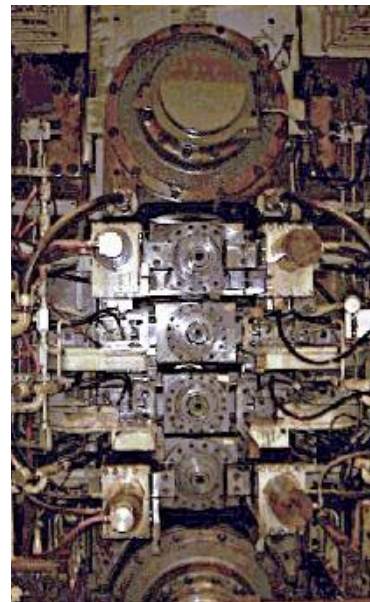
An important highlight is the speed efficiency software of SMS group which ensures optimum process control during continuous operation.

Mill window with devices for:

- positive and negative work- and intermediate roll bending
- workroll shifting (stands 1-3)
- intermediate roll shifting (stands 4 and 5)



Top: DS system for dry strip surface
Left: Housing window.



Plant concept.



Operator end of the tandem cold mill.

Specially designed emulsion system for the rolling of carbon and stainless steel grades.

Five-stand CVC® continuous tandem cold mill (CTCM) – year of commissioning 1998

Annual production

Finished strip 1,978,000 t/year

Material grades

Low-carbon steels
Stainless steels

Strip data, entry section

Width
Carbon steel 609 to 2.057 mm
Special steel 609 to 1.676 mm

Thickness

Carbon steel 1.77 to 6.35 mm
Special steel 0.63 to 4.57 mm

Strip data, exit section

Thickness
Carbon steel 0.30 to 4.04 mm
Special steel 0.30 to 2.29 mm
Coil outside diameter 2,642 mm
Coil inside diameter 610 mm
Coil weight max. 49.4 t

Plant configuration

- 5 stand tandem cold mill provided with continuous entry looper
- stands 1-3 in CVC®plus 4-high design
- stands 4 and 5 in CVC®plus 6-high design
- continuous exit section with double reel
- Special inline strip inspection for strips of carbon steel and stainless steel

Dongbu Steel, South Korea



Five-stand six-high tandem cold mill with ESS technology for a minimum final thickness of 0.12 mm

SMS group 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).

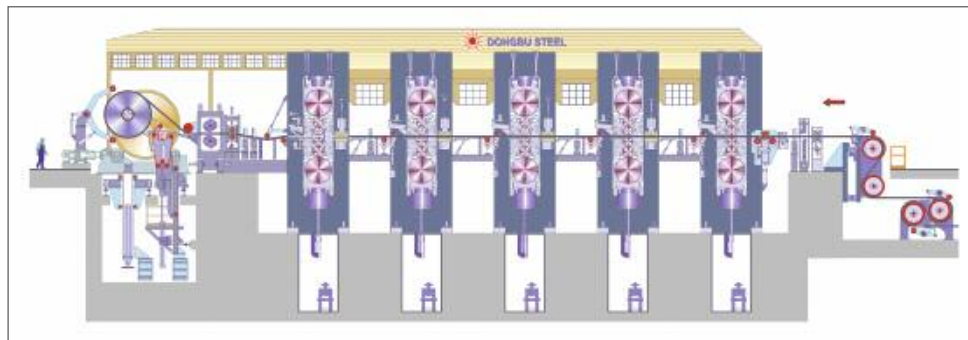
The combined pickling line/tandem cold mill is a prime example of the newly developed high-tech mills and is designed as endless mill for an annual capacity of 1.34 million tons. It is able to produce cold strip with a minimum thickness of 0.12 mm.

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.
- Easy transfer of the finished strip by means of a car-courel-type reel; coil weight increased to 45 t by using a butt-welding machine.

Mill stands with devices for:

- positive and negative work- and intermediate roll bending
- intermediate roll shifting
- enhanced shifting system (ESS)



Entry end with coupling to the pickling line.



Control stand.



Exit end with carrousel-type reel.

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.

Five-stand ESS tandem cold mill combined with a pickling line – Year of commissioning 1999

Annual production

Finished strip 1,340,000 t/year

Material grades

Low-carbon steel
Higher-strength steels

Strip data, entry section

Width 700 to 1,630 mm
Thickness 1.6 to 5.0 mm

Strip data, exit section

Thickness 0.12 to 2.3 mm
Coil inner diameter 508 mm
Coil outer diameter 2,500 mm
Max. coil weight 45,000 kg

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

ThyssenKrupp Steel, Germany

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:

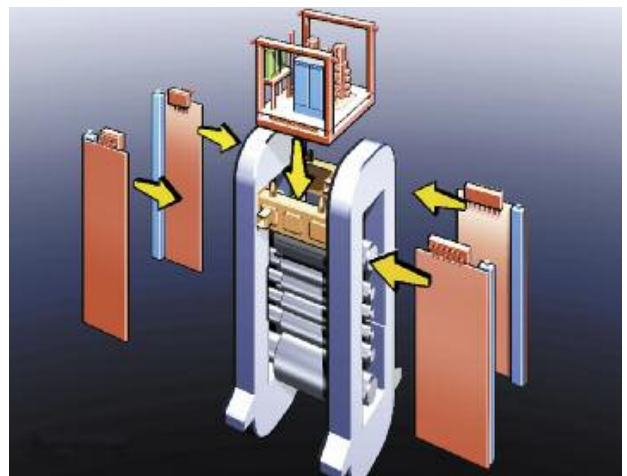
- Possibility of rolling high and higher-strength grades in large strip widths and low gauges.
- Implementation of the narrowest thickness tolerances over the strip length
- Clear improvement in flatness
- Reduction of surface defects
- Reduction of the edge drop in the strip edge area
- Improvement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

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

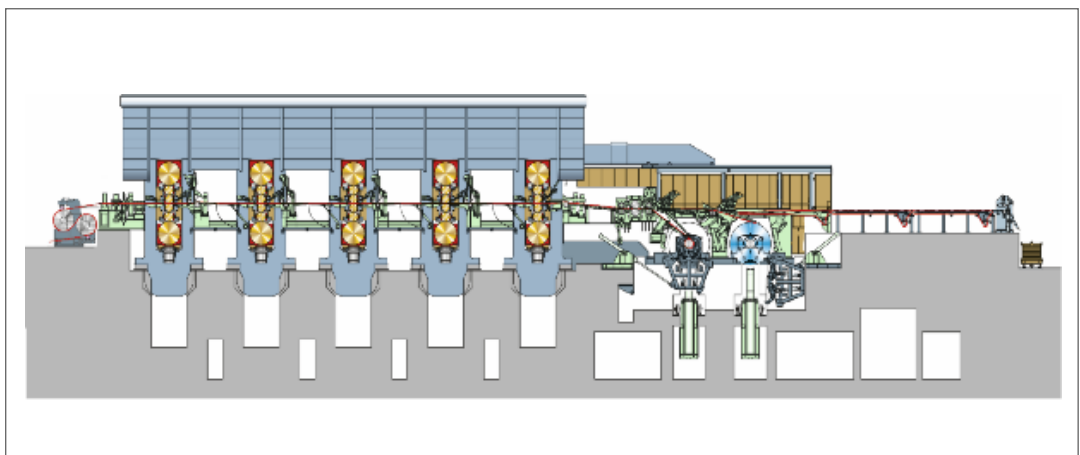
- Axial shifting of the intermediate rolls
- EDC® at mill stands 1 to 4 with level 2 models based on Plug & Work
- AIO design (All-in-One) of the piping, the side walls and the mill stand platform in modular construction
- Simultaneous work-roll change at all mill stands in less than eight minutes



Clear arrangement of the hydraulic equipment in the mill stand top section.



AIO modular construction (All-In-One).



Plant concept.



Exit side with two coilers and inline strip inspection.

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

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 Arcelor-Mittal Vega. The cold rolling mill, we erected as general contractor, produces sophisticated, high-quality products.

In the first construction stage Arcelor Mittal Vega produced 880,000 t/year of cold strip. In 2009 SMS group 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.

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 million tonnes.



Drum shear with pinch roll units in the exit section.

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.

As prime contractor we erected the cold strip facility for the production of challenging high quality products. It provides the automotive and electrical industry nearby with pickled hot strip, rolled thin sheet as well as galvanized cold strip. The production lines were built by a pool of suppliers under our management in cooperation with Brazilian SMS Siemag Equipamentos e Servicos Ltda.



We supplied a pickling line/tandem cold mill, an inline temper mill and a separate temper mill as well as a recoiling and inspection line and we were responsible for the turnkey project management.



Left: Continuous exit section with second tension reel.
Right: Strip inspection line.

View of the tandem cold mill from the entry end.

Short erection and start-up time of only ten months.

Four-stand CVC® tandem cold mill combined with a pickling line – Year of commissioning 2003

Annual production

Finished strip	
Phase 1	880,000 t
Phase 2	1,400,000 t

Material grades

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

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	762 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

Handan Iron & Steel, China



Pickling line/tandem cold mill (PL-TCM) for 1.38 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 1.38 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.



Control stand in the exit section.



Carousel reel.



Housing window of six-high stand.



View of the rolling mill from the entry end.

Inspection of the combined pickling line/tandem cold mill and the skin-pass mill for cold strip took place only 6 months after the rolling of the first strip.

Five-stand CVC® tandem cold mill combined with a pickling line – Year of commissioning 2005

Annual production

Finished strip 1,380,000 t

Material grades

Low-alloyed carbon steels
High-strength low-alloyed steels
Silicon-alloyed steels

Strip data, entry section

Width 930 to 1,680 mm
Thickness 1.8 to 5.0 mm
Coil outer diameter 1,100 to 2,050 mm
Max. coil weight 33,600 kg
Coil inner diameter 760 mm

Strip data, exit section

Width 900 to 1,665 mm
Thickness 0.25 to 2.0 mm
Coil outer diameter 1,100 to 2,000 mm
Max. coil weight 33,300 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 and prepared for subsequent installation of EDC®
- Continuous exit section with carousel reel
- Offline strip inspection station

Baotou Iron & Steel, China



Acceptance of the coupled 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.



*View of the rolling mill
from the entry end.*

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 1.43 million t of high-grade steel strips.

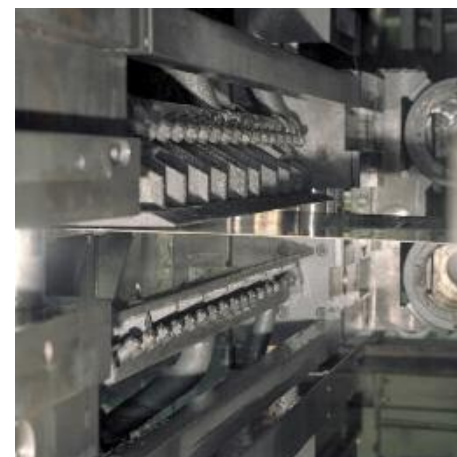
It is able to produce strips with minimum thicknesses of 0.25 up to 3.0 mm and widths up to 1,540 mm. The hot strip for the new cold rolling mill is produced by a CSP® facility, which was also supplied by us and which was already commissioned in August 2001.

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.

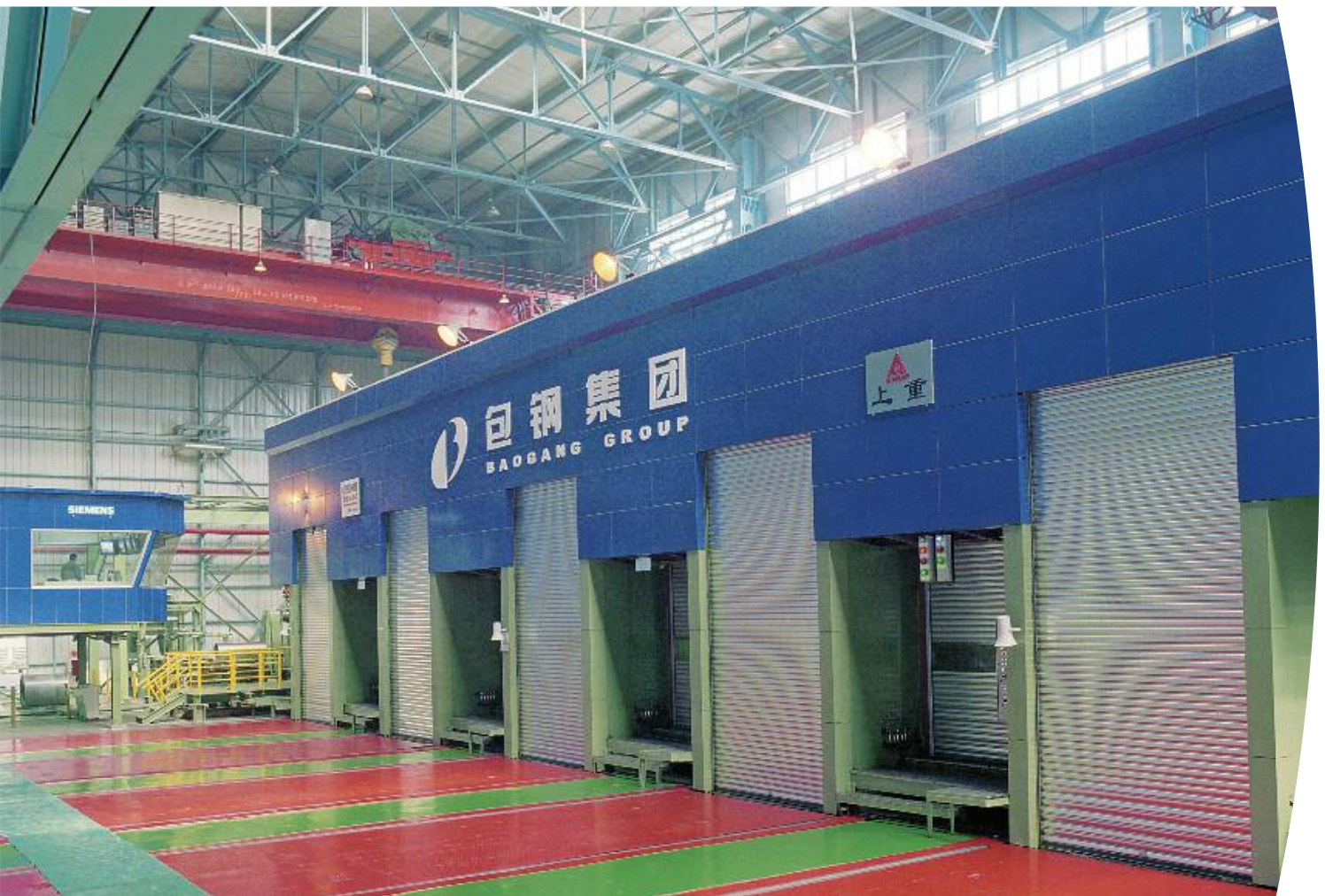
With this investment, Baotou had expanded its spectrum of products. By means of the continuous process chain established here - from the CSP® plant to the surface finishing facilities with innovative technologies from SMS group - Baotou is able to maintain its market position in the face of the increasing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



Main pulpit, exit section with carousel reel.



Arrangement of the multi-zone cooling system.



The five-stand rolling mill.

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

Five-stand CVC® tandem cold mill combined with a 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 1,560 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

Wuhan Iron & Steel, China



Expansion of the 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 830 to 2,080 mm are produced with the best surface quality and best flatness.



*Entry section
tandem cold mill.*



Roll change.



Assessment of the first rolled coil.



Tandem cold mill.

***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 – Year of commissioning 2005

Annual production

Finished strip 2,300,000 t

Material grades

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

Strip data, entry section

Width 800 to 2,080 mm
Thickness 1.5 to 6.0 mm
Coil outer diameter 1,000 to 2,150 mm
Max. coil weight 38,000 kg
Coil inner diameter 762 mm

Strip data, exit section

Width 830 to 2,080 mm
Thickness 0.3 to 2.5 mm
Coil outer diameter 1,000 to 2,150 mm
Max. coil weight 38,000 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 six-high design with EDC®
- Continuous exit section with carousel reel
- Offline strip inspection station

Shougang Group, China



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 carousel reel. Highly powerful suction and filter systems ensure environmentally friendly operation.



Removal of a coil from the carousel reel.

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.



Entry end.



Roll change.



The tandem rolling mill with carousel reel.

Shougang produces steel strips of top quality for automotive applications at Beijing-Shungi.

Five-stand CVC® tandem cold mill combined with a pickling line – Year of commissioning 2007

Annual production

Finished strip 1,800,000 t

Max. coil weight

38,000 kg

Coil inner diameter

760 mm

Material grades

Low-alloyed carbon steels

High-strength steels

Strip data, exit section

Width 800 to 1,870 mm

Thickness

Low-alloyed carbon steels 0.2 to 2.5 mm

Coil outer diameter 1,000 to 2,100 mm

Max. coil weight 38,000 kg

Coil inner diameter 610 mm

Strip data, entry section

Width 800 to 1,900 mm

Thickness 1.6 to 6.0 mm

Coil outer diameter 1,000 to 2,150 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® facilities
- Continuous exit section with carousel reel
- Offline strip inspection station

Steel Dynamics Inc., Flat Rolling Group Columbus Division, USA

Cold rolling mill with five-stand pickling line/tandem cold mill (PL-TCM)

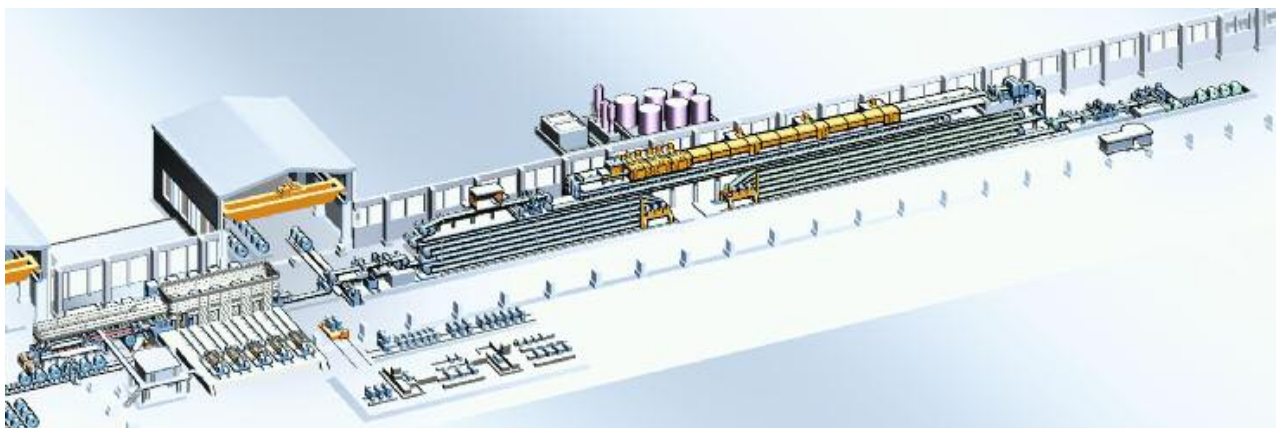
Steel Dynamics Inc., Flat Rolling Group Columbus Division (formerly SeverCorr), USA, had placed a major order with us in the autumn of 2005 for the supply of all production facilities for an integrated works, ranging from steel production to hot strip, from cold rolling to strip refining. The cold rolling 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 1,880 mm, the minimum thickness 0.27 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.



Layout of the coupled combined pickling line/tandem cold mill allows flexible production: pickled strip can either be oiled and be sold or it can be further processed in the tandem cold mill.



View of the tandem cold mill.

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 a 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 1,880 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

Since 2008 Baoshan Iron & Steel Co. Ltd., based in the Chinese province of Shanghai, is operating a coupled pickling line/tandem cold mill by SMS group. 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. 1.74 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.



Automatic work roll change.

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.



The carousel reel with inspection line.



The pickling line.



Exit view of the coupled pickling line/tandem cold mill.

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 1,737,500 t

Material grades

Low-alloyed carbon steels
Multi-phase steels

Strip data, entry section

Width 700 to 1,650 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

Thickness 0.25 to 2.3 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

Tianjin Tiantie Metallurgical Group, China



**Tianjin Tiantie
Metallurgical Group**

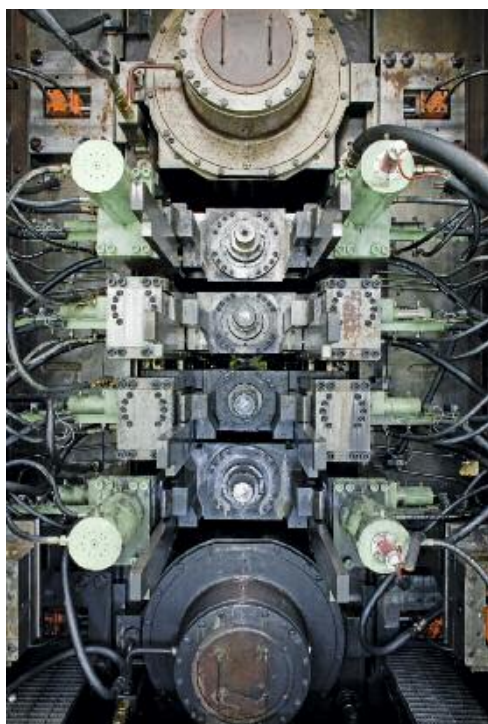
The Tianjin Tiantie Metallurgical Group Co. Ltd., was founded in 1995. The firm evolved from the Tianjin Steel Factory, which has been in existence since 1969. In spring 2006, Tiantie awarded us a contract for the supply of a combined pickling line/tandem cold mill.

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 group.

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.



Housing window of one of the five six-high stands.



Carousel reel.



Roll change device.



Entry end of the tandem cold rolling mill.

Five-stand CVC® tandem cold mill combined with a pickling line – Year of commissioning 2007

Annual production

Finished strip 1,600,000 t

Material grades

Low-alloyed carbon steels

High-strength low-alloyed steels

Strip data, entry section

Width 730 to 1,600 mm

Thickness 1.80 to 6.00 mm

Coil outer diameter 1,100 to 2,150 mm

Max. coil weight 30,400 kg

Coil inner diameter 762 mm

Strip data, exit section

Width 700 to 1,600 mm

Thickness 0.25 to 2.00 mm

Coil outer diameter 1,100 to 2,150 mm

Max. coil weight 30,400 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

Posco, South Korea



Fully-continuous tandem cold mill with 18-roll mill stands for stainless steel

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, 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.



Continuous tandem cold mill with four 18-roll mill stands.

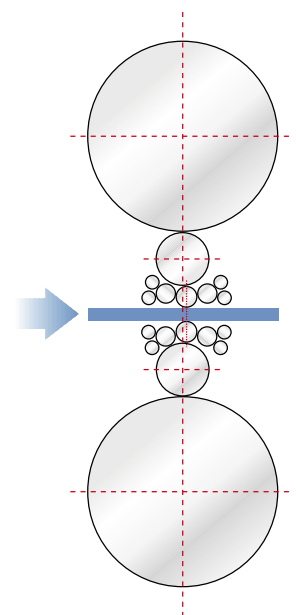
Optimized through T-roll®

We used our T-roll® 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 a drum-type shear as well as two tension reels with continuous paper feed. 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.





Overview of the continuous tandem cold mill.

Fully continuous mill for high stainless steel production.

Continuous tandem cold mill for stainless steel in 18-HS design – Year of commissioning 2009

Annual production

Finished strip 500,000 t/year

Material grades

Stainless-steel hot and cold strip

Strip data, entry section

Width 600 to 1,350 mm

Thickness

Hot strip 1.8 to 5.0 mm

Cold strip 0.8 to 2.0 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

AM/NS Calvert, USA



Works complex for hot and cold strip

AM/NS Calvert (former ThyssenKrupp Steel) located in the US federal state of Alabama, is known as one of the most modern production facilities for hot and cold strip worldwide. SMS group erected a hot strip mill, a pickling line/tandem cold mill as well as numerous strip processing lines.

With an annual capacity of 2.1 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 800 to 1,870 mm wide strips are then joined together into an endless strip in a laser welding machine from SMS group, with this strip being continuously pickled in

the turbulence pickling line at a process speed of max. 270m/min. The turbulence pickling section with length of 3 x 35 m is controlled by a process model for the most exacting surface requirements as well as for easily picklable strips and strips that are difficult to pickle.

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



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



Tandem cold mill.

Five-stand CVC® tandem cold mill combined with a pickling line – Year of commissioning 2010

Annual production

Finished strip 2,100,000 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

MMK, Russia



The world's most powerful coupled pickling line/tandem cold mill

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

MMK is one of Russia's leading steel producers and, by means of this investment, expanded its production of cold-rolled and galvanized strip to a high standard of quality. This strip is used 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 pickling line/tandem cold mill with an annual capacity of approx. 2.0 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.



All the stands use the CVC®plus technology. At the last stand, a multi-zone cooling system and the dry-strip system for drying the strip are additionally installed. The facility is equipped with the "Rotary Inspect" inline inspection line to enable quality control to take place during the actual production process.

The entire automation system was set up in our test facilities beforehand and tested according to the Plug & Work concept. Plug & Work simulates the production sequence and allows the automation functions to be tested and optimized under realistic conditions prior to installation in the works.



Tandem cold mill with inline inspection line („Rotary Inspect“).



Powerful drive systems.



Tandem cold mill.

Five-stand CVC® tandem cold mill combined with a pickling line – Year of commissioning 2011

Annual production

Finished strip 2,000,000 t

Material grades

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

Strip data, entry section

Width 880 to 1,880 mm
Thickness 1.2 to 6.0 mm

Coil outer diameter 1,200 to 2,500 mm
Max. coil weight 43,500 kg
Coil inner diameter 850 mm

Strip data, exit section

Width 880 to 1,880 mm
Thickness 0.28 to 3.0 mm
Coil outer diameter 1,200 to 2,500 mm
Max. coil weight 43,500 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
- X-shape shapemeter rolls
- Continuous exit section with two coilers
- “Rotary Inspect” inline strip inspection station

Handan Iron & Steel, China



Pickling line/tandem cold mill for 2.15 million t of cold strip

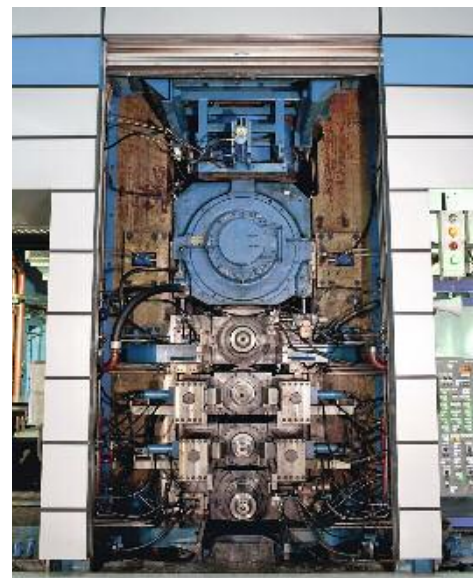
In January 2008, the Handan Iron & Steel Group Han-Bao Company Ltd placed an order with us as consortium leader for the supply of a combined pickling line/tandem cold mill. The Handan & Baosteel joint venture is setting up this new cold rolling mill complex on the premises of Handan.

The rolling mill is designed for an annual production of 2.15 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 built in China.

Mill stand equipped with CVC®plus 6 high roll set.



Best accessibility: mill stand platform.



Offline strip inspection station.



Coil evacuation from carousel reel.

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 900 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

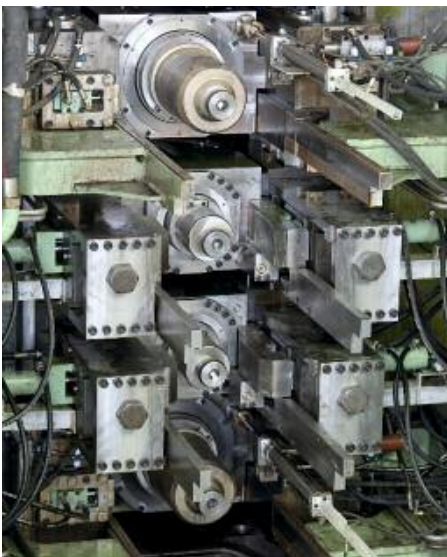
- Five-stand tandem cold mill coupled to a continuous pickling line
- All mill stands in CVC®plus six-high design with ESS, prepared for subsequent installation of an edge-drop control system EDC®
- Continuous exit section with carousel reel
- Offline strip inspection station

Shougang Jingtang, China

SGJT

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 group 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.



*CVC®plus 6 high set
with ESS.*

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 group, Shougang Jingtang has been able to expand its product range to include the products and grades required by the market.



Rollchange.



View of the plant.

Five-stand CVC® tandem cold mill combined with a pickling line – Year of commissioning 2010

Annual production

Finished strip 2,221,000 t

Material grades

Low-alloyed carbon steels
High-strength low-alloyed steels
Silicon-alloyed steels

Strip data, entry section

Width 900 to 2,080 mm
Thickness 1.5 to 6.0 mm
Coil outer diameter 1,000 to 2,200 mm
Max. coil weight 42,000 kg
Coil inner diameter 762 mm

Strip data, exit section

Width 870 to 2,080 mm
Thickness 0.40 to 2.50 mm
Coil outer diameter 1,000 to 2,200 mm
Max. coil weight 42,000 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 EDC®
- Continuous exit section with carousel reel
- Offline strip inspection station

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, being erected at the Toranagallu Vidyanagar (Bellary) location in India. The customer was impressed above all by the low drive costs and maintenance costs of our plant concept.

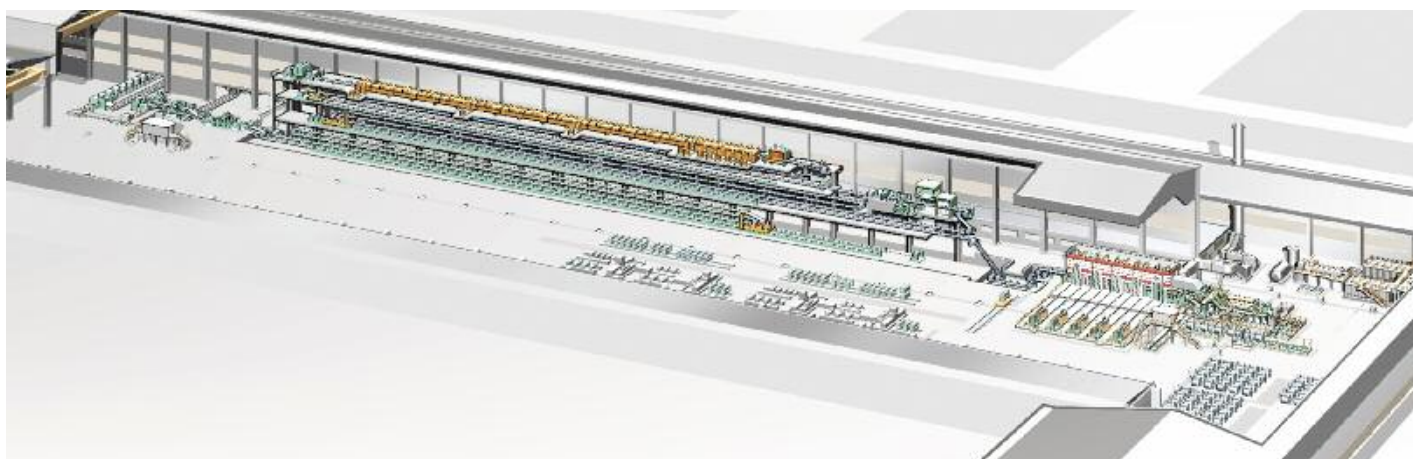
On the new pickling line/tandem cold mill, JSW Steel Limited produce strips in high-quality steel grades as from 2013 and is supplying these to the automotive industry.

The comprehensive supply scope included the entry section, equipped with two payoff reel groups and with a SMS group 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 carrousel 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 supplied 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 carrousel 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.



Coupled pickling line/tandem cold mill.



Tandem cold mill.

Five-stand CVC® tandem cold mill combined with a pickling line – Year of commissioning 2013

Annual production

Finished strip 2,300,000 t

Coil inner diameter

762 mm

Coil weight

max. 40,000 kg

Material grades

Low alloyed carbon steels,
high strength low alloyed steel,
multiphase steel

Strip data, exit section

Width 800 - 1,890 mm

Thickness 0.3 - 2.6 mm

Coil outer diameter 900 to 2,600 mm

Coil inner diameter 610 mm

Coil weight max. 50,000 kg

Strip data, entry section

Width 800 - 1,890 mm

Thickness 1.5 - 6.5 mm

Coil outer diameter 1,100 to 2,200 mm

Plant configuration

- Five-stand tandem cold mill coupled to a continuous pickling line
- All mill stands in CVC®plus six-high desizing and ESS, prepared for subsequent installation of EDC®
- Continuous exit section with carrousal reel
- Offline strip inspection station
- Prepared for later integration of an inline inspection

Shanxi Taigang Stainless Steel Company, China



Integrated tandem mill for stainless-steel cold strip in 18-HS design

Chinese stainless steel producer TISCO (Shanxi Taigang Stainless Steel Company), a subsidiary of the Taigang Group International Trade Co. Ltd., had awarded SMS group a contract for a fully continuous cold tandem mill in 18-HS design, featuring a strip cleaning section. This investment gives TISCO an extra capacity of half a million t of stainless-steel strip per year.

The cold rolling mill forms the heart of an integrated, continuous production line for stainless-steel cold strip, also known as a white sheet rolling annealing and pickling line (WRAPL). The new production line was erected by a consortium in Taiyuan city in the Chinese province of Shanxi. The WRAPL configuration ensures TISCO produces stainless steel especially cost-effectively because rolling, annealing, and pickling all take place in one pass.

As the supplier of the tandem mill, the strip cleaning section, and the tension roll sets, SMS group is a significant member of the consortium. The tandem mill processes hot strip pre-treated in a hot strip annealing and pickling line also supplied by SMS.

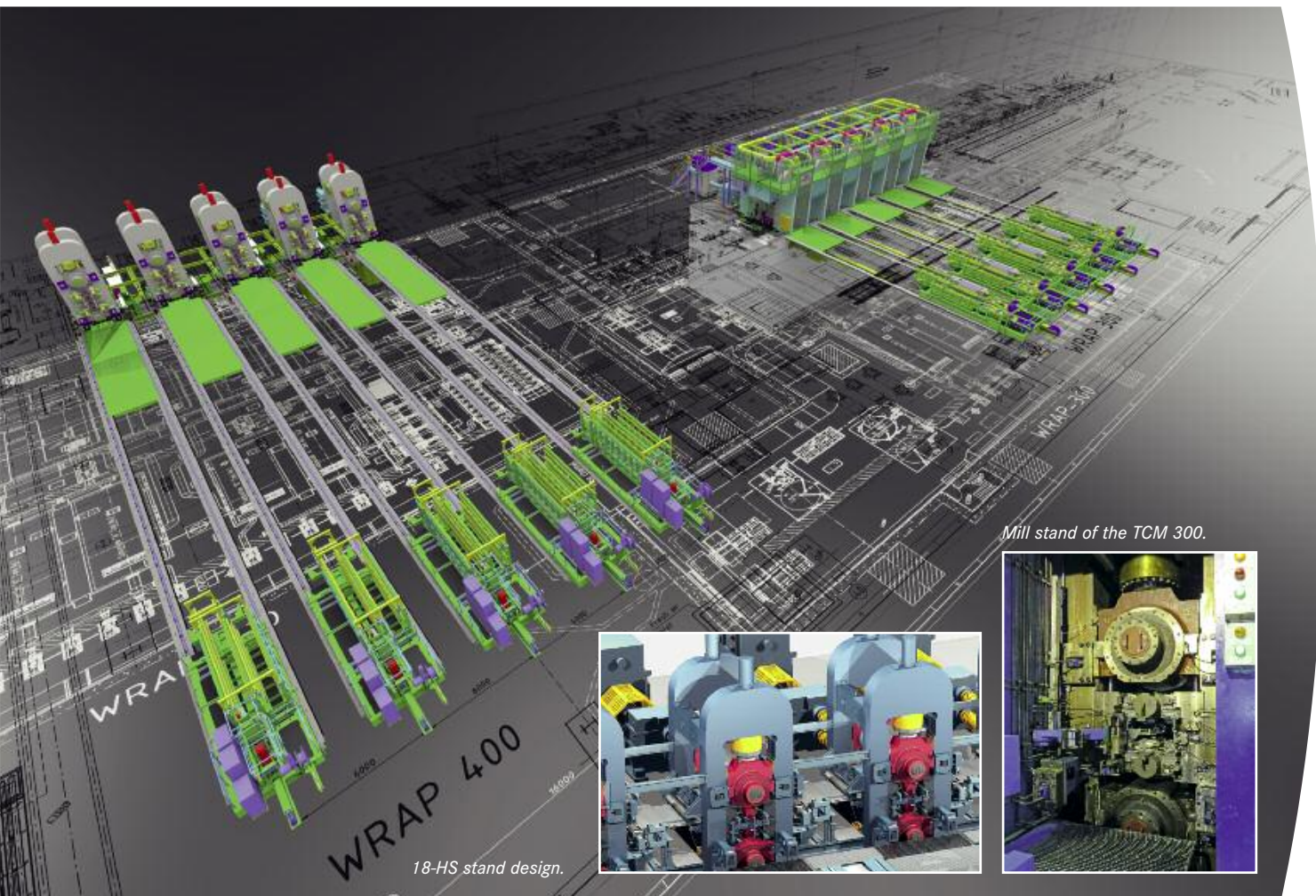
This TCM 300 tandem mill in 18-HS design is the second of its kind in the world. The first was built by SMS group in 2009. It rolls AISI 300-series stainless-steel strip and has an annual capacity of up to 600,000 t. The annealed and pickled stainless-steel strip enters the five-stand mill at a speed of up to 170 meters per minute.

Further down the line, the top process speed in the run-out area is 370 meters per minute. Here, the finished coils weigh a maximum of 35 t. The high-tech tandem line features five mill stands in 18-HS design (HS = horizontal stabilization). Particularly high reductions per pass result from the slimline work rolls, making production especially cost-effective.

Completing the tandem mill is a strip cleaning section from SMS group. Some 30 meters long, the horizontal cleaning section removes residual rolling emulsion from the surface in several process stages. The stages are separated from each other by squeeze rolls, and each stage has its own circulation system.



The TCM 300 tandem mill for stainless steel during commissioning.



Mill stand of the TCM 300.

18-HS stand design.

Shanxi Taigang Stainless Steel contracted SMS group to supply two tandem mills for stainless steel cold strip to China. On the right, the TCM 300 with five stands in 18-HS design.

Five-stand integrated 18-HS tandem cold mill – Year of commissioning 2014

Annual production

Finished strip 600,000 t

Material grades

Stainless-steel strip
AISI 300 series

Strip data, entry section

Width 1,040 - 1,650 mm
Thickness 2.0 - 6.0 mm
Coil weight max. 35,000 kg

Strip data, exit section

Width 1,040 - 1,650 mm
Thickness 2.0 - 6.0 mm
Coil weight max. 35,000 kg

Plant configuration

- Five-stand tandem cold mill integrated in a so-called continuous "White sheet rolling annealing and pickeling line (WRAPL)"
- All stands in 18-HS design

- Servohydraulic roll-gap control (AGC)
- HS shifting for the work rolls
- Intermediate roll shifting system
- Intermediate roll bending system
- Emulsion system for cooling and filtering the coolant-lubricant used
- Mathematical model for presetting all rolling parameters
- Thickness control systems
- Strip cleaning section

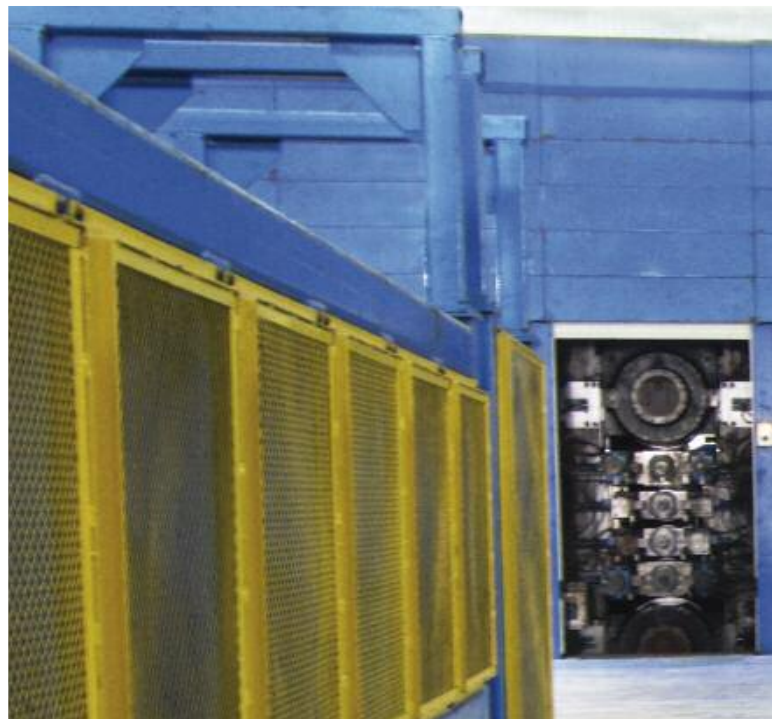
Shanxi Taigang Stainless Steel Company, China



Inline tandem cold mill for stainless steel strip in CVC®plus 6-high design

SMS group supplied a second tandem cold mill (TCM 400) here in CVC®plus 6-high design and a second strip cleaning section to the Chinese stainless steel strip producer TISCO (Shanxi Taigang Stainless Steel Company). This tandem cold mill was also integrated in a continuous production line for stainless steel cold strip. The coupling of the process steps rolling, annealing and pickling enables TISCO producing in a very efficient way. This makes TISCO being the first stainless steel producer worldwide operating two fully continuous cold strip production lines in parallel. With both lines, TISCO increased production of about more than one million tons per year.

On the TCM 400 hot rolled annealed and pickled stainless steel strip is rolled up to an annual capacity of 500,000 t. The 6-high stands are equipped with comparably small work rolls with diameter ranges down to minimum 420 mm, resulting in high pass reductions. All five mill stands are provided with CVC®plus. In combination with positive and negative work and intermediate roll bending and the multizone cooling in the last stand, the tandem cold mill is provided with all state-of-the-art rolling technologies and is able to meet the high quality



requirements concerning thickness and flatness of the strips rolled. The maximum rolling speed in the exit section is 340 meters per minute.



The downstream strip cleaning section removes emulsion residues from the surface of the finished stainless steel strip. It is characterized by compact design, efficient cleaning and low operating costs.



The tandem cold mill „TCM 400“ in the final stage of assembly.

Five-stand inline CVC®-tandem cold mill integrated in Rolling-, Annealing- and Pickling Line
Year of commissioning 2014

Annual production

Finished strip 500,000 t

Material grades

AISI 400 series

Strip data, entry section

Width: 1,040 – 1,650 mm
 Thickness: 2.0 – 6.0 mm
 Coil weight max. 35,000 kg

Strip data, exit section

Width: 1,040 – 1,650 mm
 Thickness: 0.6 – 2.0 mm
 Coil weight max. 35,000 kg

Plant configuration

- 5 stand tandem cold mill integrated in a so called continuous „White sheet rolling annealing and pickling line (WRAPL)“
- Stands in CVC®plus 6-high design
- Strip cleaning section

Bengang Steel Plates Co. Ltd., China



Pickling line/tandem cold mill sets a record in width for automotive grades

Since summer 2015, the Chinese steel producer Bengang Steel Plates Co. Ltd. (Benxi) is operating a high-performance tandem cold mill by SMS group for strips with widths up to 2,150 mm in the Liaoning province in northern China. It sets a world record within the product range of automotive grades. The cold rolling line was supplied together with two continuous annealing lines, also delivered by SMS group and is part of the new cold rolling mill No. 3 of Benxi. By this, Benxi has a capacity of more than 2 million tons of cold strip, including high strength grades like DP and TRIP at their disposal. Beside the plant technology, SMS group also provided know-how for the production of high-value automotive grades via its subsidiary MET/Con.

Benxi trusted once again in the expertise and experience of SMS group. The previous supply comprised a hot rolling mill, two reversing cold mills as well as two 20-roll cold rolling mills.

The pickling line/tandem cold mill processes a large range of material grades, comprising carbon steels, high strength and ultra-high strength steels, including multi-phase and martensitic steels.

The turbulence pickling line has a total length of more than 100 m and is provided with an upstream scale breaker of 60 t tension. This permits a high-quality strip cleaning, characterized by low energy and acid consumption and low maintenance costs.

The tandem cold mill rolls the pickled strip with ingoing maximum thickness of 6.0 mm down to minimal final gage of 0.3 mm. All five stands are designed as 6-high and operate with the new combined CVC®plus/ESS technology (ESS= Enhanced Shifting System). Co-acting with positive and negative work and intermediate roll bending provides a differentiated set up range for optimal adjustment of the roll gap. This ensures, together with the multi-zone cooling, very good flatness results. In addition, the stands have been prepared for the later installation of Edge Drop Control (EDC®). EDC® ensures constant strip thickness up to the strip edges. In the last mill stand the DS-System (Dry Strip System) takes care for efficient strip drying, keeping the finished strip free from emulsion droplets. After the strip has been rolled down to its final thickness, it is coiled by a compact carousel reel. For inspection of the finished strip there is an offline strip inspection station available.



The successful start of production was recognized in a ceremony.



Continuous exit with carousel reel.



The mill stand design is modular with integrated piping facilitating the final assembly and commissioning on site and shortening the time needed. SMS group also supplied the emulsion plant with a capacity of 37.000 liters per minute.

Five stand CVC® tandem cold mill combined with pickling line – Year of commissioning 2015

Annual production

Finished strip 2,290,000 t

Material grades

Low-alloyed carbon steels, high-strength and ultra-high strength steels including multiphase- and martensitic steels

Strip data, entry section

Width 1,000 – 2,150 mm
Thickness 1.2 – 6.0 mm

Coil outer diameter 1,000 – 2,150 mm
Coil inner diameter 762 mm
Max. coil weight 40,000 kg

Strip data, exit section

Width 1,000 – 2,150 mm
Thickness 0.3 – 2.5 mm
Coil outer diameter max. 2,150 mm
Coil inner diameter 610 mm
Max. coil weight 40,000 kg

Plant configuration

- Five-stand tandem cold mill coupled to a continuous pickling line
- All mill stands in CVC®plus/ESS six-high design, prepared for subsequent installation of EDC®
- Continuous exit section with carousel reel
- Offline strip inspection station

Big River Steel, USA



All-rounder pickling line/tandem cold mill sets new standards in green technology

Big River Steel in Osceola, Arkansas, USA is the most modern and environmentally friendly steelworks in Northern America. The company is producing high-quality steel for energy, automotive, oil and gas industry from recycled steel scrap. As provider of integrated systems, SMS group supplies all units – from the melting plant to the strip processing lines, including all drives and hydraulic components, the entire electrical equipment, the complete electrical and automation systems as well as the environmental technologies.

In the first construction stage, the facility is going to produce 1.5 million tons of hot strips. By several stages of extension, a stepwise doubling of the production is projected.

Centerpiece of the cold strip production is the coupled pickling line/tandem cold mill. It processes a very large product range with different sophisticated material requirements. The essential equipment of the pickling section comprises X-Pro® Laser Welder, scale breaker and turbulence pickling section. The X-Pro® Laser Welder allows precise and rapid welding of difficult-to-weld high alloy strips, so that the strips can travel safely through the pickling process and can be rolled afterwards without problems.

One portion of the hot strip is pickled and sold as pickled and oiled hot strip. Approximately one million tons of pickled hot strips will be rolled in the tandem cold mill.

The tandem cold mill comprises 5 stands in 4-high design. State-of-the-art measuring systems, regulation strategies and control elements ensure the sophisticated required strip quality. Included here is the X-Shape flatness measurement roll, which stands out for its robustness with closed roller surface, precise flatness

measuring and reliable optical and wear-free signal transmission.

Proven control elements such as CVC®plus technology, positive and negative work roll bending, highly dynamic hydraulic adjusting systems as well as a multizone cooling in the last stand, guarantee top strip flatness and thickness tolerances. This stand technology meets the extremely high requirements of the automotive industry on product quality while operating at low costs.

There are two tension reels in the exit area for continuous coiling of the rolled strip. Belt wrappers help to protect the valuable finished strip from damage during coiling. Featuring Rotary Inspect the tandem cold mill is provided with the most modern inline strip inspection line for a safe, prompt and ergonomically optimized evaluation of the strip surface quality.

Yet there is even more that makes the tandem line operator-friendly as well as reducing non-productive times: for instance the fully automatic work roll changing device coming with an automatic coupling system for all media.

The tandem line also sets new standards, when it comes to green technology and maintenance-friendliness. Cutting-edge oil-air lubrication of the bearings on all roller levels reduces lubricant consumption. Furthermore, axial bearings on all roller levels extend the service life of the roller bearings. The tandem cold mill is equipped with a fume exhaust system of the latest generation. It acts early in the process, controlling the air flow to reduce fume generation at source. That ensures compliance with the extremely strict US particle emission laws. Moreover, the system is highly energy efficient, just like all the media supply systems and auxiliary plants. Instrumental here are speed-controlled pumps for precise, money-saving media supply.



Delivery of a mill stand of the tandem cold mill to its final destination Osceola in the US federal state Arkansas.



The pickling line/tandem cold mill concept offers BRS high flexibility in hot strip processing.

Five-stand CVC®-tandem cold mill combined with a pickling line – Year of commissioning 2016

Annual production

Finished strip 1,000,000 t

Material grades phase 1

Low-, medium- and higher alloyed carbon steels, deep drawing grades (EDDS), IF and DDS, high-strength low alloyed steels (HSLA), multi-phase steels

Strip data, exit section pickling line (P&O)

Width 914 – 1,880 mm
Thickness 1.4 – 5.0 mm

Strip data, entry section TCM

Width 914 – 1,880 mm
Thickness 1.4 – 5.0 mm
Coil outer diameter max. 2,100 mm
Coil inner diameter 760 mm
Max. coil weight 40,000 kg

Strip data, exit section TCM

Width 914 – 1,880 mm
Thickness 0.27 – 1.4 mm
Coil outer diameter max. 2,100 mm
Coil inner diameter 610 mm
Max. coil weight 40,000 kg

Plant configuration

- Five-stand tandem cold mill coupled to a continuous pickling line
- All stands in CVC®plus-4-high design
- X-Shape flatness measuring roll
- Continuous exit with double reel
- Inline strip inspection Rotary Inspect
- Latest generation fume exhaust system

Shandong Iron and Steel Rizhao, China



Pickling line tandem cold mill with innovative technologies in the new flat steel complex for automotive grades

Shandong Iron & Steel Rizhao, China, has contracted the SMS group 2016 to supply a complete flat steel complex. Beside the hot and cold rolling lines, and the strip processing lines, parts of the supply scope are also a newly developed quality assurance system and comprehensive process know-how. The flat steel complex will be erected at the Chinese east coast in the Shandong province.

With the annual capacity of approx. 2 million t, the central production plant for cold strip production is the coupled five-stand tandem cold mill. It processes a major part of the hot strip, produced on the high-performance hot strip mill further to high grade cold strip with width between 900 up to 1,880 mm and a final thickness range between 0.3 and 2.5 mm. Rolling at the full speed of 1,450 meters per minute is possible, even with the smallest diameter work rolls being installed in the 6-high stands.

On the entry side, the pickling line is provided with two pay-off stations, welding machine, tension leveler and a newly developed especially efficient exhaust system. The pickling section is realized as turbulence tank pickling system. In order to cut the strip edges to the required width, an ASC side trimmer is integrated in the entry section of the tandem cold mill. A total of three horizontal loopers ensure the continuous strip flow in the process section and the transition to the tandem cold mill.

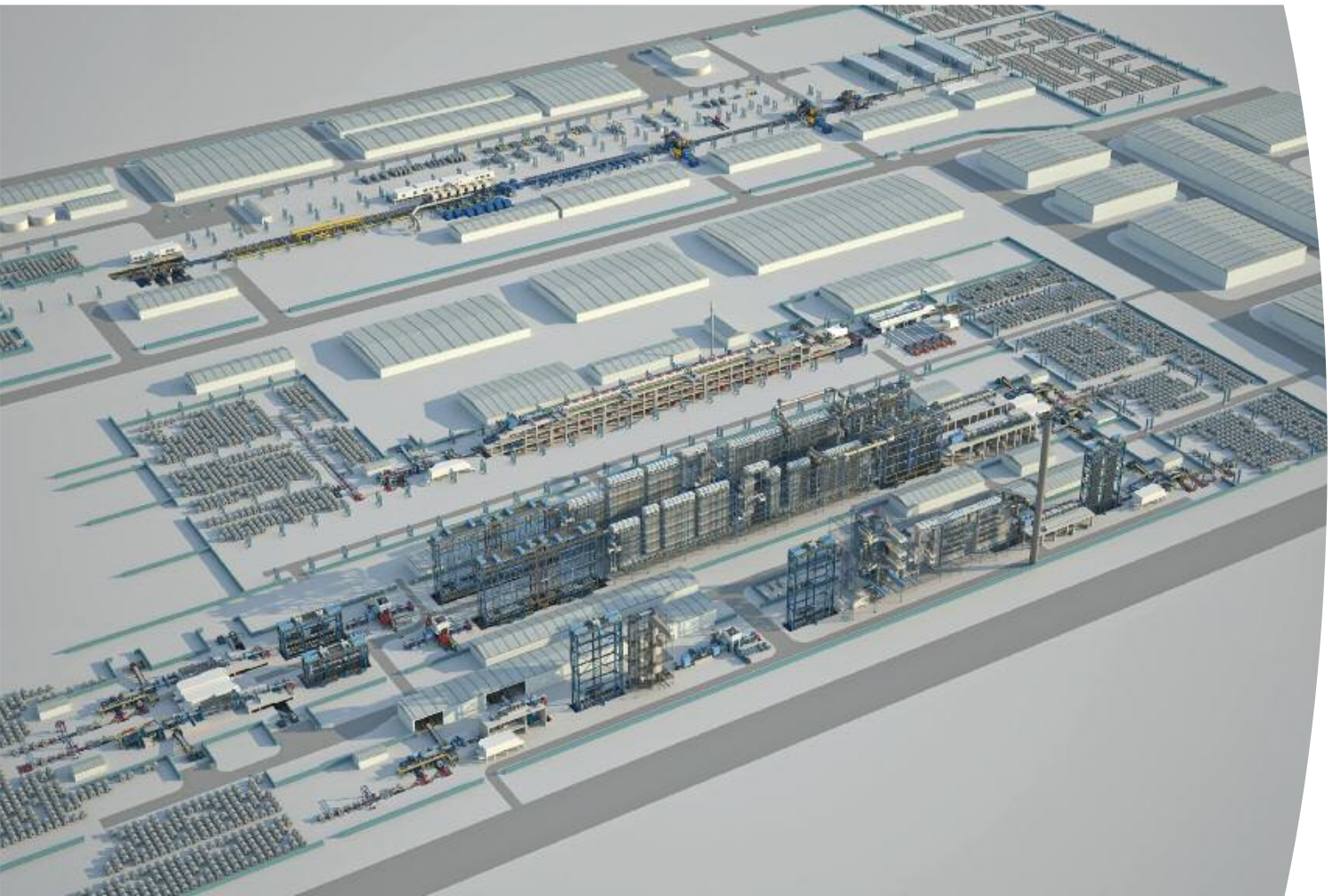
All of the five six-high mill stands in the tandem cold mill will be equipped with the proven CVC®plus technology and the Enhanced Shifting System (ESS) for strip thickness and flatness control permitting the roll gap geometry to be adjusted to an extremely wide product range. Media supply will be modular to the all-in-one design. Multi-zone cooling and a state-of-the-art dry strip system in the last mill stand will optimize the flatness and the surface quality of the rolled strip. To reduce off-size lengths, a compact and robust carousel reel will coil the strips. Furthermore, SMS group supplies an inline inspection system, type Rotary Inspect, to constantly check the surface quality, as well as coil transport equipment, marking machine, exhaust and media systems.

The new emulsion system developed by SMS group, the so-called Emulsion Compact Unit (ECU), features an extremely small footprint. Due to its clever design and the use of waste heat from the rolling process, the ECU needs less energy than a conventional emulsion system.

SMS group supplies the pickling line-/tandem cold mill from one source including the X-Pact® electrical and automation systems. A central part of this project is the implementation of an X-Pact® PQA system (Product Quality Analyzer), which has the task to monitor, document and secure the process and the products right up to the surface-finished cold strip. For this purpose, all relevant production data will be recorded and analyzed in a continuous manner. Based on pre-defined rules, the system will issue instructions for action, so that possible irregularities in the production process can be responded to in due time so as to ensure high yield at optimal quality.



Concept of the continuous high-performance pickling line/Tandem cold mill.



The pickling line/tandem cold mill is the „heart“ of the new flat steel production complex, supplied to Shandong Iron & Steel by SMS group.

Furthermore, the manufactured products will be assessed with regard to their suitability for various applications. The main benefits for Shandong are the immediate identification and elimination of quality issues, high process stability

combined with increased yield and a higher acceptance on the part of the end customer thanks to complete documentation of the entire production process.

Five-stand CVC®-tandem cold mill combined with a pickling line – Year of commissioning: 2017

Annual production

Finished strip 2,067,000 t

Material grades

CQ, DQ, DDQ, EDDQ, SEDDQ, BH, HSLA, HSS, DP und TRIP

Strip data, entry section

Width 900 – 1,880 mm
Thickness 1.8 – 6.0 mm
Coil outer diameter 1,100 – 2,230 mm

Coil inner diameter

762 mm

Max. coil weight

40,000 kg

Strip data, exit section

Width 900 – 1,880 mm
Thickness 0.3 – 2.5 mm
Coil outer diameter 1,000 – 2,165 mm
Coil inner diameter 610 mm
Max. coil weight 40,000 kg

Plant configuration

- Five stand tandem cold mill combined with a continuous pickling line
- All stands in CVC®plus 6-high design with ESS
- Continuous exit with carousel reel
- Inline strip inspection station Rotary Inspect
- Emulsion Compact Unit (ECU)
- X-Pact® Product Quality Analyzer (PQA)

References

Customer	Plant type/ number of stands	Material	Annual capacity cold strip
NLMK, Russia	5-stand C-TCM	Carbon steel	1,200,000 t
ArcelorMittal, Weirton, USA	5-stand TCM	Carbon steel	885,000 t
WISCO, China	5-stand TCM	Carbon steel	275,000 t
Bethlehem Steel, USA	5-stand TCM	Carbon steel	520,000 t
Baoshan Iron & Steel, China	5-stand TC-TCM	Carbon steel	2,100,000 t
National Steel, Phillippines	5-stand TCM	Carbon steel	520,000 t
Posco, South Korea	5-stand PL-TCM	Carbon steel	1,000,000 t
Armco, USA	3-stand TCM	Stainless steel	440,000 t
Posco Industries, USA	5-stand PL-TCM	Carbon steel	1,413,000 t
Sumitomo Metal, Japan	5-stand C-TCM	Carbon steel	1.2 to 1.4 million t
Baoshan Iron & Steel, China	5-stand PL-TCM	Carbon steel	780,000 t
Hyundai Hysco, South Korea	5-stand PL-TCM	Carbon steel	1,550,000 t
Usiminas, Brazil	5-stand PL-TCM	Carbon steel	1,000,000 t
AK Steel, USA	5-stand C-TCM	Carbon steel/ Stainless steel	1,180,000 US-t
Dongbu Steel, South Korea	5-stand PL-TCM	Carbon steel	1,340,000 t
ThyssenKrupp Steel AG, Germany	5-stand PL-TCM	Carbon steel	2,100,000 t
ArcelorMittal Vega, Brazil	4-stand PL-TCM	Carbon steel	1,400,000 t

Customer	Plant type/ number of stands	Material	Annual capacity
Handan Iron & Steel, China	5-stand PL-TCM	Carbon steel	1,373,000 t
Baotou Iron & Steel, China	5-stand PL-TCM	Carbon steel	1,432,000 t
Wisco, China	5-stand PL-TCM	Carbon steel	2,300,000 t
Shougang Group, China	5-stand PL-TCM	Carbon steel	1,793,000 t
Steel Dynamics Inc., USA	5-stand PL-TCM	Carbon steel	1,814,000 t
Baoshan Iron & Steel, China	5-stand PL-TCM	Carbon steel	1,737,000 t
Tianjin Tiantie, China	5-stand PL-TCM	Carbon steel	1,600,000 t
Posco, South Korea	5-stand C-TCM	Stainless steel	500,000 t
AM/NS Calvert, USA	5-stand PL-TCM	Carbon steel	2,100,000 US-t
MMK, Russia	5-stand PL-TCM	Carbon steel	2,100,000 t
Handan Iron & Steel, China	5-stand PL-TCM	Carbon steel	2,150,000 t
Shougang Jingtang, China	5-stand PL-TCM	Carbon steel	2,221,000 t
JSW Steel, India	5-stand PL-TCM	Carbon steel	2,300,000 t
Shanxi Taigang Stainless Steel, China	5-stand C-TCM	Stainless steel	600,000 t
Shanxi Taigang Stainless Steel, China	5-stand C-TCM	Stainless steel	500,000 t
Bengang Steel Plates, China	5-stand PL-TCM	Carbon steel	2,280,000 t
Big River Steel, USA	5-stand PL-TCM	Carbon steel	1,500,000 t
Shandong Iron & Steel Rizhao, China	5-stand PL-TCM	Carbon steel	2,000,000 t

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