

A new steel plant complex for SDI Setting new benchmarks with CSP[®] NEXUS technology



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Steelmaking plant

The steelworks will be equipped with two direct-current electric arc furnaces (EAF) with a capacity of 210 short tons (190 metric tons) each, plus two twin-station ladle metallurgy furnaces (LMF) and a twin vacuum tank degasser (VTD). It will have an annual liquid steel capacity of over three million short tons.

Gas cleaning plant (GCP)*

The gas cleaning plant efficiently and effectively captures and cleans the dust-laden gas emitted by the production units. To comply with the environmental protection and work safety regulations at the site in Sinton, Texas, USA, the company must have a reliable system in place to prevent fugitive emissions.

Widely varying gas volumes are intercepted throughout all operating phases of the steelmaking plant. In the EAF, most of the dust-contaminated exhaust gas is trapped and cooled from approximately 2,550 °F (1,400 °C) to less than 1,110 °F (600 °C) in an indirectly water cooled duct section.

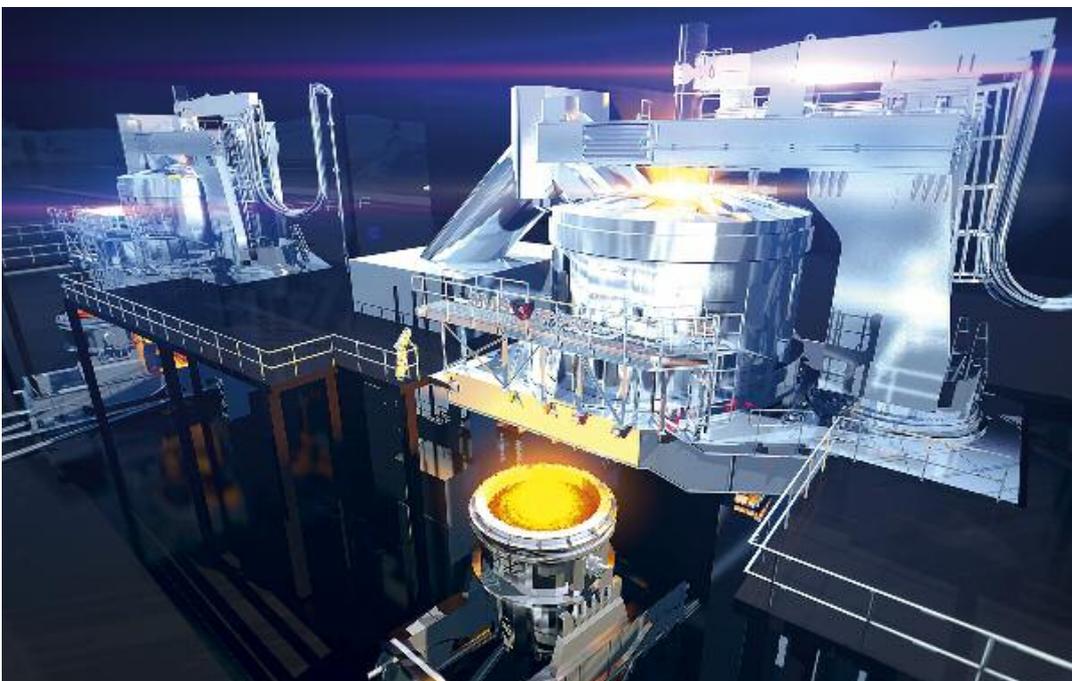
EAF direct dust collection consists of a movable elbow, a combustion chamber where post combustion of the CO-laden offgas takes place and coarse particles can settle, and a downstream hot gas duct. Other dust-laden gas flowing from the EAF is safely captured by the canopy. In addition, both work positions of each LMF are connected to the GCP.

Electric Arc Furnace (EAF) Ladle Metallurgy Furnace (LMF)

The SDI meltshop is designed to produce large volumes of high-quality steel grades, including low carbon, medium carbon, high-strength low-alloy, and line pipe steel.

The two DC electric arc furnaces produce heats at a rate of over 500 short tons (450 metric tons) per hour. Moreover, the two twin-station LMFs offer the flexibility of treating four heats simultaneously. The EAF and LMF are connected via V-track ladle transfer systems to ensure fast heat processing without the use of cranes. This proven steelmaking technology ensures that only the highest-quality steel is delivered to the CSP® NEXUS thin slab caster.

*within SDI scope



The high-current power supply system, including transformers and rectifiers will be supplied by X-Pact® Electrical and Automation systems from the SMS group. The close integration of all steel plant technological process models together with the production planning system ensure an innovative, optimized, and flexible production process.

Vacuum Tank Degasser (VTD)

The twin vacuum tank degasser is designed with innovative vacuum tank transfer capability between the degassing station and LMF reheating station. This layout enables degassing, reheating, and final trimming of ladles to be achieved without additional ladle crane handling. Common SMS XL-Pro mechanical vacuum pumping modules are utilized for fast and energy efficient vacuum pumpdowns.

Technical data

Gas cleaning system

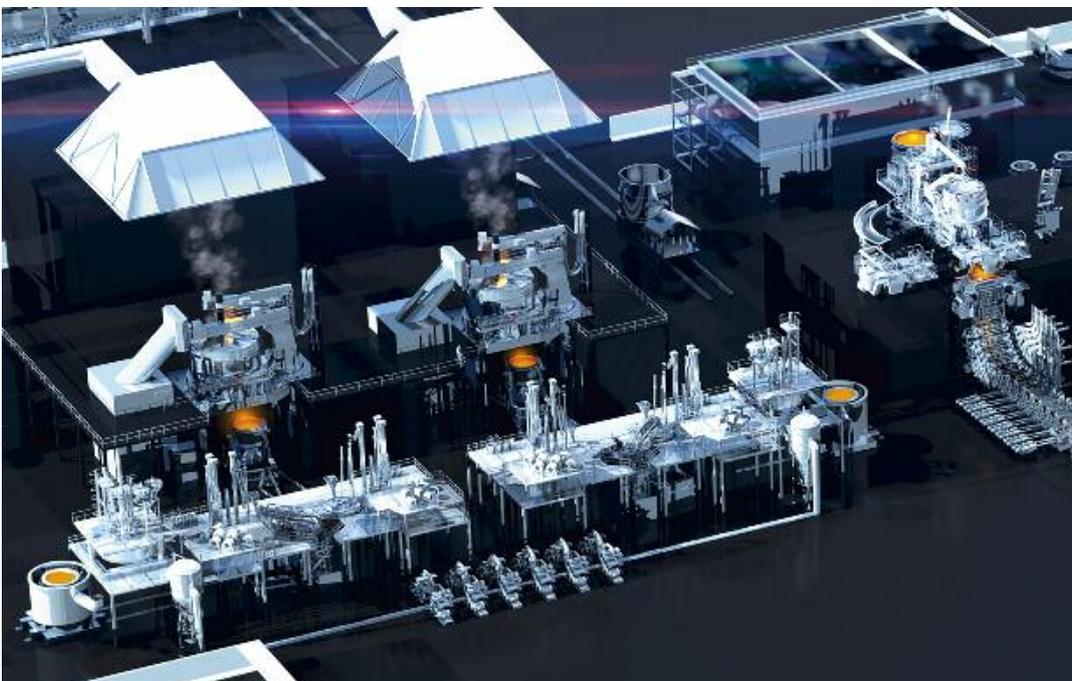
Nominal capacity	3,300,000 SCFM
Filter type	Reverse air, 28 compartments

EAF

Capacity	3,100,000 short tons/year (2,810,000 mt/year)
EAF heat weight	210 short tons (190 mt)
EAF type	DC, EBT with patented pin-type anode
EAF power	176 MW each
LF type	Twin-station with common electrodes
LF power system	28/32 MVA each

VTD

VTD type	Twin-tank with common vacuum system
Cycle time	Approx. 30-45 min
VD pumping capacity	250,000 m ³ /hr @ 0.67 mbar
Pumpdown time	Approx. 5 mins
Steel grades	Sheet steel including ULC, HSLA and pipe steels



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CSP® NEXUS connects you to a new level of hot strip production

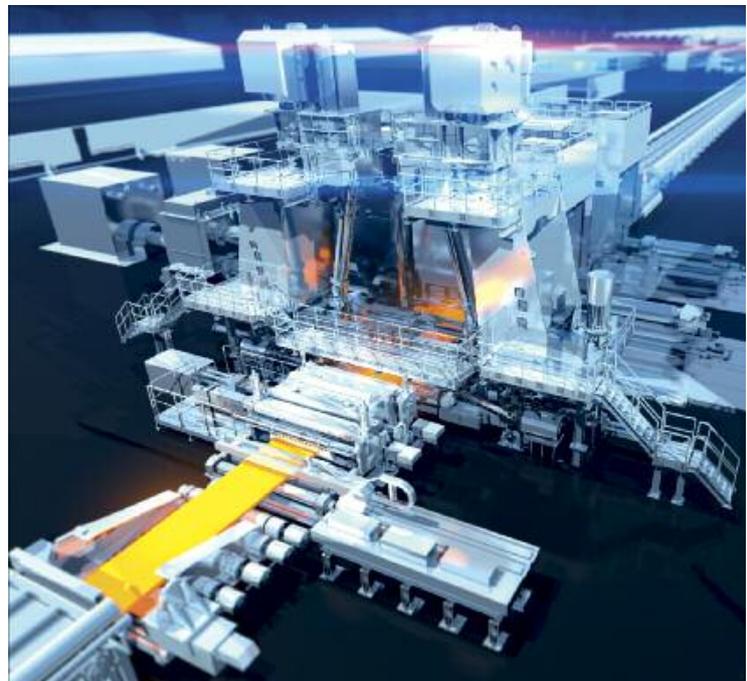
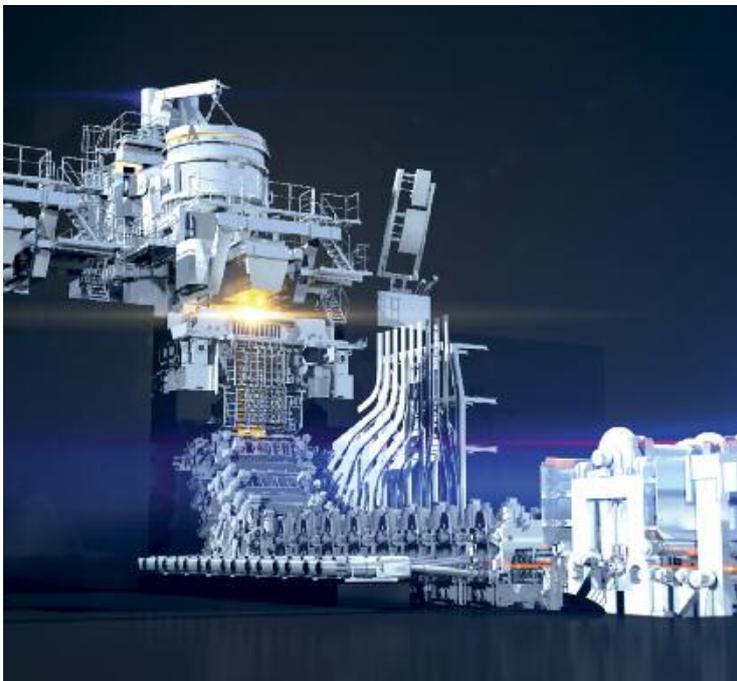
The CSP® NEXUS combines high productivity and product quality with the homogeneous temperature distribution and low operational costs for which SMS group CSP® technology is well known. With a maximum strip width of 84 in (2,134 mm) and an annual capacity of 3.0 million short tons (2.7 million mt), SMS group is once again setting the dimension and production possibilities for thin slab casting and rolling plants.

At the same time, the design of this mill allows the production of high quality thin strip, down to a minimum strip thickness of 0.047 in (1.2 mm), as well as API hot strip grades with thicknesses of up to 1 in (25.4 mm). Even thinner final strip thicknesses are possible with this plant concept. The central technological feature of the CSP® NEXUS is the flexible adjustment of the temperature profile and the high reduction capacity of the independent rolling mill groups, with a roller hearth furnace in front of and behind the roughing mill.

The distances between the caster and roughing mill as well as between the roughing mill and finishing mill allow casting, roughing-edging-rolling, and finish-rolling to be performed independently, to achieve the most favorable production basis that takes the steel grade and product dimensions into account. The resulting layout creates the basis for producing high-quality final products, especially in terms of final rolling temperature (uniformity) requirements.

The new bow type casting machine of the CSP® NEXUS plant has a metallurgical length of over 82 ft (25 m) and will enable SDI to produce thin slabs with thicknesses of up to 5.5 in (140 mm). The caster design is based on a vertical mold and first segment followed by bow and horizontal segments. With a casting speed of up to 236 in/min (6 m/min) and the resulting throughput, this single strand CSP® NEXUS plant is set to become a benchmark in thin slab casting and rolling technology.

The caster automation systems featuring X-Pact® Level Control ensure highly dynamic steel flow control for a stable mold level. HD mold^{TC} (TC – Thermocouples) transparently maps the casting conditions inside the mold and points out surface defects. X-Pact® Width Control includes delta speed adjustment, which allows for larger width changes with shorter transition lengths and less stress on the strand shell. X-Pact® Solid Control monitors and calculates the strand solidification and optimizes the cooling conditions under variable casting conditions. X-Pact® Gap Control enables Liquid Core Reduction (LCR plus), with which the slab thickness can be variably adjusted to the optimum entry thickness in the CSP® NEXUS mill, and Dynamic Soft Reduction® for improved internal quality. The X-Pact® Cast Optimizer assigns order data to production data, optimizes width adjustments, cut lengths, and casting speeds, and tracks and documents the whole production process. X-Pact® Tech



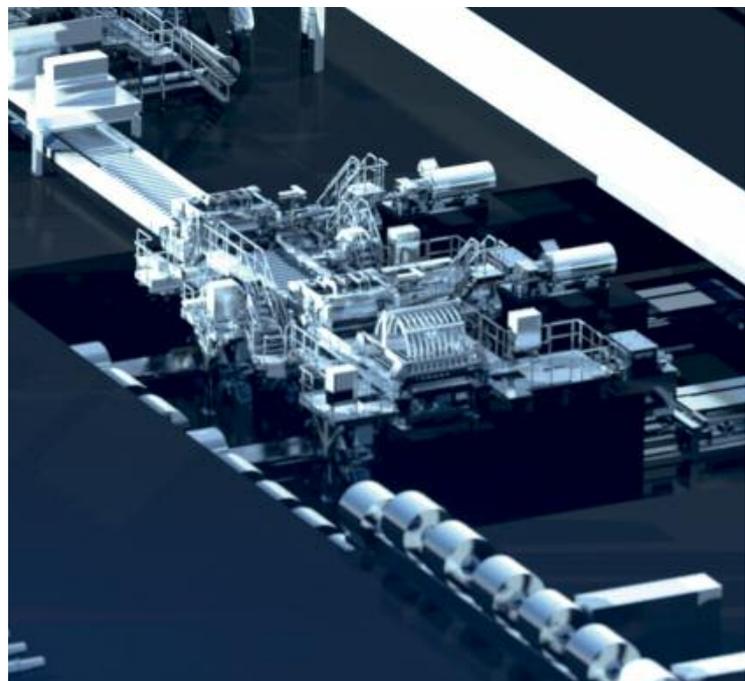
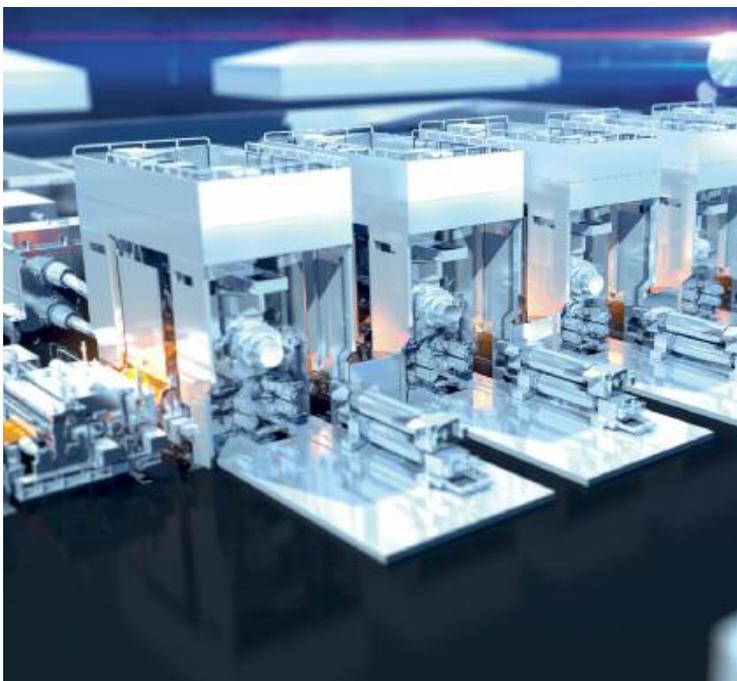
Assist manages all techno-metallurgical parameters in one centralized system and creates individual independence. Downstream of the caster, a pendulum shear with a nominal shearing force of maximum 24,900 kN will be the strongest pendulum shear built for a CSP® plant to date. The first furnace features batch rolling mode and sets the required slab temperature conditions for the rolling process. Special high load furnace rolls are used for smooth slab transportation and optimum surface quality. The second furnace is located downstream of the roughing stands, after the transfer bar cooling device. Both furnaces use environment-friendly, ultra-low NOx burners for the process. To save energy, the combustion air is preheated with waste heat from the furnace that is recovered by recuperators. The X-Pact® Dynamic Furnace Control system ensures highly dynamic process regulation of the furnace heating zone. The process model precisely calculates the set points for the temperature, heating time, acceleration, and buffer time, in addition to the 3D temperature distribution over the entire length of each slab, and also allows for energy savings. The active slab guiding system in front of the roughing mill and finishing mill ensures better centering of the slabs as they enter the mill stands. At the entry side of each rolling process, two high-pressure descaling systems ensure the required clean surface before rolling, thus ensuring surface quality.

The heavy-duty roughing mill features two vertical edgers, two powerful roughing stands, and a transfer bar cooler downstream of the second rougher. The independent roughing/rolling process using the X-Pact® automation system provides the ideal basis for high quality API grades. The flexible adjustment of temperature, rolling speed, draft, and cooling volumes guarantees the best possible conditions for the downstream finishing process.

The finishing mill consists of 6 powerful mill stands with X-Pact® automation for excellent geometrical properties and optimal surface quality. All mill stands are equipped with a pass-line adjustment system and newly designed top thrust plate shifting units, which enable faster backup roll changes and less maintenance work in the roll shop.

The reinforced top and bottom laminar strip cooling system is equipped with the highly efficient edge water removal system. Water collectors on the drive side and operator side can be operated independently. Together with the innovative edge masking process model, this ensures excellent cold strip flatness.

Located below floor level at the end of the runout table, two downcoilers with a 1,944 hp (1,450 kW) mandrel drive are the strongest downcoilers ever built for a CSP® plant that corresponds to the product range of a NEXUS rolling mill. The entire rolling mill is also equipped with X-Pact® basic and process automation systems. X-Pact® Width Control at the



edgers provides a constant strip width over the entire strip length to ensure optimal caster mold settings. Together with the X-Pact® Crop Optimization system, maximum yield is ensured thanks to precise strip width accuracy and minimized crop cut lengths.

The X-Pact® Strip Steering Control and X-Pact® Tail-Out Monitoring systems are responsible for safely guiding the strips in a straight line through the finishing mill by offering far greater stability in the production of thinner gauges, especially at the head and tail ends. Throughout the whole rolling mill, X-Pact® Profile Contour and Flatness Control guarantees the highest product quality and provides extremely flexible rolling campaigns. In addition to the laminar cooling system, the related X-Pact® Cooling Section Control system and X-Pact® Microstructure Property Model allow the prediction of the perfect product properties for the final hot rolled products. The CSP® NEXUS process will be followed by a downstream pickling line/5 stand tandem cold mill (PL/TCM), which will partly process the hot strip to produce premium cold strip.

Electrical and automation systems

The new complex will be equipped with the whole X-Pact® electrical and automation systems package from SMS group. This includes the entire low voltage (LV) drive system, sensors and measuring devices, basic and process automation systems, HMI, and safety concepts. By concentrating on characteristics such as high productivity, flexibility, product quality, availability, and safety, X-Pact® provides a solid foundation for both current and future requirements.

Extensive diagnostic and assist features facilitate the interaction of the operating and maintenance personnel with the process and related equipment. As these focus on the actual process data and steps, non-productive times are noticeably shorter and there is less need for operator intervention.

X-Pact® implements the vast technological experience of SMS group, developed over many years of supporting our customers. The challenging product diversity, high throughput, and required product quality are key parameters in the design of our X-Pact® technology packages.

Ready for Digitalization

The CSP® NEXUS for SDI is furthermore equipped with a basic digital package, which will support the startup, commissioning, ramp-up and operation of the plant. The proven Product Quality Analyzer (POA®) system will make sure that coils being shipped to customers meet their order specifications. The Plant Visualization System (PVS) will support oper-

Technical data	
Production data	
Annual production	3.0 million short tons (2.7 million mt)
Strip width	38 in – 84 in (965 mm – 2,134 mm)
Caster	
Ladle capacity	210 short tons (190 mt)
Tundish capacity	66 short tons (60 mt)
Slab thickness	(5.51 in) 5.118 in – 4.33 in (140 mm) (130 – 110 mm) via LCR plus
Furnace 1	
Maximum furnace temperature	2,246 °F (1,230 °C)
Slab exit temp., max.	2,165 °F (1,180 °C)
Furnace length	382 ft (116 m)
Rollers	113
No. of burners	90
Roughing stands	
No. of edgers	2
No. of stands	2
Transfer bar thickness	2.36 in – 1.378 in (60 – 35 mm)
Furnace 2	
Maximum furnace temperature	2,120 °F (1,160 °C)
Furnace length	337 ft (103 m)
Rollers	116
No. of burners	67
Finishing mill	
No. of stands	6
Final strip thickness	0.047 in – 1 in (1.2 – 25.4 mm)
Max. coil weight	52.6 short tons (47.7 mt)

ators and maintenance personnel, especially for those who do not have a longtime experience in a steel plant. Smart Alarm will provide an overview of current alarms and warnings in the system and thus increase the speed and reliability for maintainability. All data stored will be completely confidential and secure for SDI's use only.

3

Continuous pickling line

A pickling line/5 stand tandem cold mill (PL/TCM) will be arranged downstream of the CSP® NEXUS plant. To meet future demand, the process section of the pickling line will feature SMS group's latest turbulence technology and a 600-kN leveling unit. An upstream payoff reel allows the pickling line and tandem cold mill to be operated in a coupled mode or independently of each other.

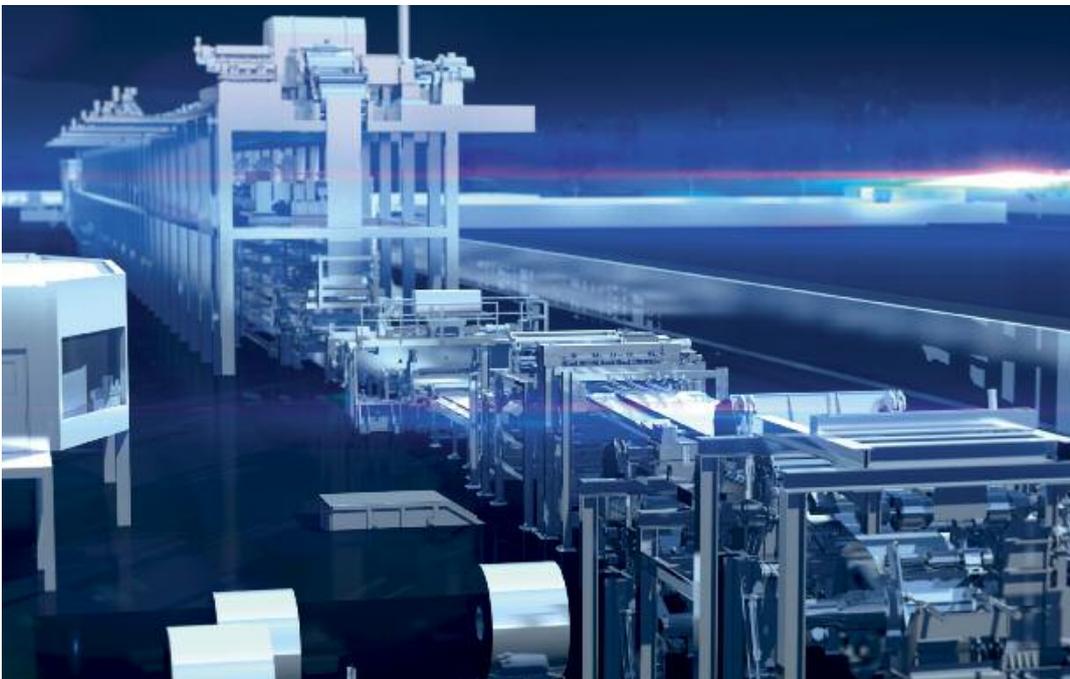
This means that the hot strip can be either pickled and oiled or guided directly to the tandem cold mill. The annual pickling capacity will be 1.1 million short tons (1.0 million mt).

The modularized software architecture of the X-Pact® automation at the pickling line is supported by the state of the art automation hardware platform Siemens S7. The X-Pact® functional modules are proven in several of processing lines realized in the last years. During the "plug and work" integration test, the complete line will be tested in pickling mode and pickling/cold rolling mode.

Technical data

Technical details for pickled and pickled & oiled material grades (P&O)

Process type	turbulence pickling technology
Process tank length	4 pickling tanks, length 82 ft (25 m) each, total: 328 ft (100 m)
Hot strip dimensions:	
Entry strip width	78 in – 38 in (1,981 mm – 965 mm)
Entry strip thickness	0.25 in – 0.047 in (6.35 mm – 1.2 mm)
Entry speed:	max. 1,476 ft/min (450 m/min)
Pickling speed:	max. 820 ft/min (250 m/min)
Exit speed:	max. 919 ft/min (280 m/min)
Annual capacity	1,100,000 short tons (1,000,000 mt)



Five-stand Tandem Cold Mill (TCM)

The TCM is characterized by its outstanding flexibility, as it is suitable both for continuous operation, in conjunction with the pickling line (PL), and for batch operation. For this challenge, the high sophisticated X-Pact® total roll gap control (TRC®) is responsible. A threading in and tailing out system minimizes strip off-gauge weight and/or lengths and therefore increases the yield substantially. The five-stand/ six-high TCM is designed to roll a wide range of materials that each come with their own requirements.

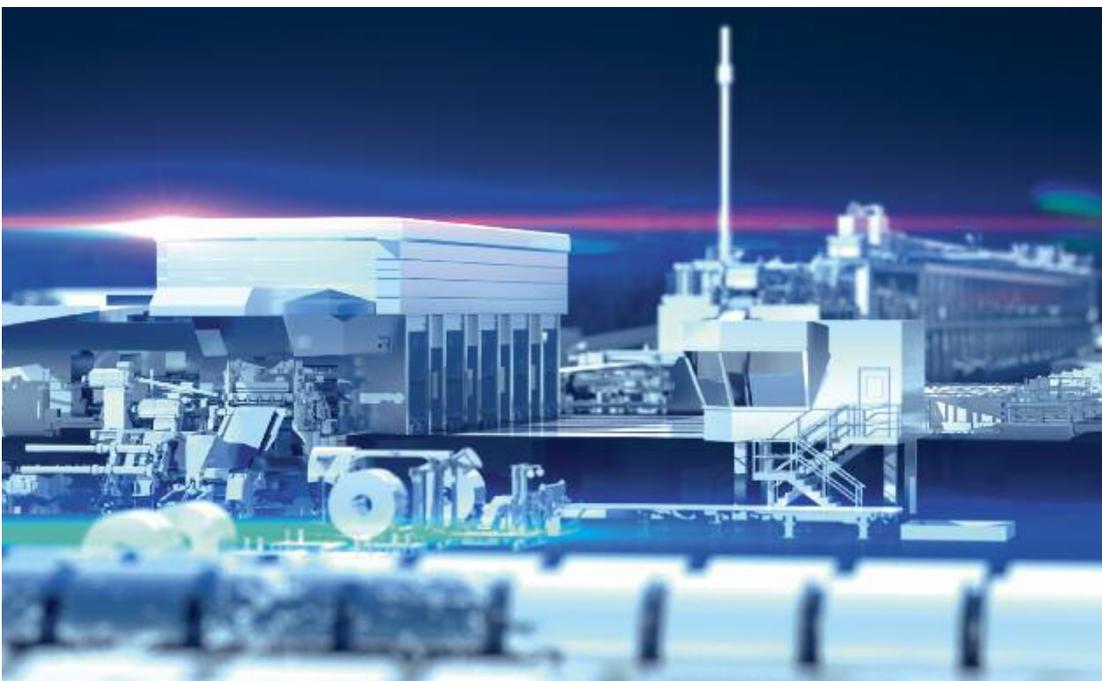
Proven control elements, such as CVC®plus technology combined with enhanced shifting system (ESS) for the intermediate rolls, positive and negative work and intermediate roll bending, highly dynamic hydraulic adjustment systems and multizone cooling in the last stand, together with the X-Shape flatness measurement and control system guarantee optimal strip flatness and thickness tolerances. The dry strip system in the last stand has low compressed air requirements and prepares the strip surface for downstream processes.

Contributing to the high proportion of high-strength steels, the carousel reel is equipped with the new revolving mandrel support bearing. It prevents lowering of the mandrel during coiling and allows for higher tension winding, thereby ensuring higher reductions and improved flatness at the strip head end. The exit section includes an offline inspection stand for ergonomic, fast, and comprehensive inspection of the finished strip.

Technical data

Mill type	5-stand 6-high
Max. roll force	30,000 kN
Back up roll diameter	max. 55 in (1,400 mm) min. 49 in (1,250 mm)
Intermediate roll diameter	max. 22 in (560 mm) min. 19 in (480 mm)
Work roll diameter	max. 17 in (450 mm) (driven) min. 16 in (400 mm) (driven)
Strip width	max. 78 in (1,981 mm) min. 38 in (965 mm)
Strip thickness (entry)	max. 0.25 in (6.35 mm) min. 0.047 in (1.2 mm)
Strip thickness (exit)	max 0.10 in (2.54 mm) min. 0.008 in (0.20 mm)
Rolling speed	max. 3969 ft/min (1,210 m/min)
Annual capacity	850,000 short tons (770,000 mt)

The TCM is equipped with the latest generation of emission control technology. The new design provides a push-pull system with air nozzles and specially designed exhaust hoods, resulting in lower released-air volume rates. The system ensures that the stringent limit values for filterable and condensable substances in the released air are met.



5

Batch annealing*

The batch annealing facility consists of 12 workbases with related inner covers, furnaces, and cooling bells. Once a workbase has been charged with coils, with conveyor plates sandwiched between them, an inner cover is placed over the coil stack. The inner cover flange is clamped down hydraulically, and a leak down test is performed before purging with nitrogen.

The heating bell is placed over the inner cover and the specific heating cycle can begin. Hydrogen is introduced into the coil stack inside the inner cover, and an extremely powerful atmospheric convection system ensures that uniform through-coil temperatures are attained, so that the specific mechanical properties and grain size are consistent throughout each charge.

After the heating process, the heating bell is turned off and removed from the workbase. At this point, the cooling bell is placed over the inner cover and the coil charge is cooled down to roughly 320 °F (160 °C) inside the inner cover.

Air/water cooling is carried out in a number of steps, depending on the desired annealing cycle. At the end of cooling the workload space is purged with nitrogen

*within SDI scope

Technical data

Batch annealing

100 % hydrogen batch annealing for cold rolled strip

Annual capacity	250,000 short tons (226,800 mt)
Coil O.D.	maximum 78 in (1,981 mm) minimum 46 in (1,168 mm)
Coil I.D.	24 in (610 mm)
Strip thickness	maximum 0.10 in (2.54 mm) minimum 0.01 in (0.254 mm)
Strip width	maximum 76 in (1,930 mm) minimum 36 in (914 mm)
Operating temperature	536 °F - 1,382 °F (280 °C - 750 °C)

before the inner cover is unclamped and removed. The coil charge is then removed and the workbase prepared for the next annealing cycle. All of these functions are controlled by the workbase PLC and automation process control system for the annealing workshop.



6

Continuous galvanizing/ galvalume line

For cold and hot strip galvanizing, the plant will be equipped with a continuous galvanizing line (CGL) that includes a horizontal Drever furnace heated by a direct-fired and a radiant-tube zone. The line will be prepared for the later installation of an ultra-fast gas cooling section to allow high-strength steel to be produced in future.

The scope of supply also includes a DUMA-BANDZINK air knife system, which ensures a homogeneous and precise zinc layer thickness and guarantees high surface quality. A change system with two zinc pots will allow the strips to be coated with a conventional zinc layer or an aluminum-zinc alloy.

For post-treatment, the line will be equipped with a four-high skin-pass mill stand, a tension leveler, and two horizontal shuttle-roll coaters, as well as with an oiling machine in the exit section.

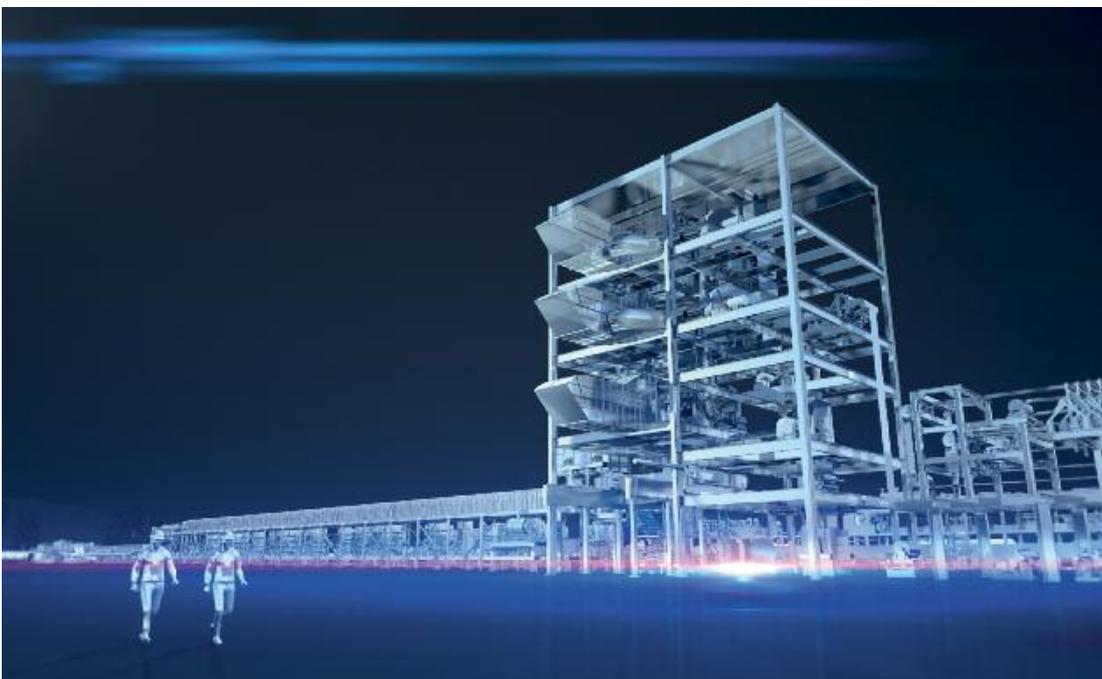
The galvanizing line will be able to process strip with a thickness of up to 0.16 in (4 mm) and a width of up to 76 in (1,930 mm). Its annual capacity will be 524,000 short tons (475,400 mt).

Technical data

Continuous galvanizing line

Strip width	38 in - 76 in (965 - 1,930 mm)
Strip thickness	0.01 in - 0.16 in (0.25 - 4 mm)
Entry speed	900 ft/min (274 m/min)
Process speed	650 ft/min (198 m/min)
Exit speed	900 ft/min (274 m/min)
Annual production	524,000 short tons (475,400 mt)

As in the pickling line, the automation system of the CGL will be the SMS X-Pact® automation system on the hardware platform Siemens S7. The X-Pact® basic automation system for the terminal equipment, process equipment, as well as the furnace automation with furnace model, will be linked by a proven system realized in many lines during the last years.



7

Temper mill

As part of the discontinuous process route, the Temper Mill (TM) is arranged after the batch annealing facility. Its main function is to provide the annealed carbon strips with the material properties required for downstream processing. This includes harmonizing the yield points as well as attaining the desired strip roughness and flatness. To ensure high strip quality, the temper mill comes with both Hydraulic Gap Control (HGC) and a strip blow-off system on the exit side. It can be operated with two different work roll diameter ranges, depending on the material requirements. Using different work roll diameters in combination with a given roll force ensures operators can extend their product range. That means the skin pass mill can be adjusted flexibly to different material demands.

The most remarkable feature of the mill is the high roll force of 18 MN. As a result, very high degrees elongation of up to 8.5 percent are possible. The temper mill is provided with a wet skin pass system.

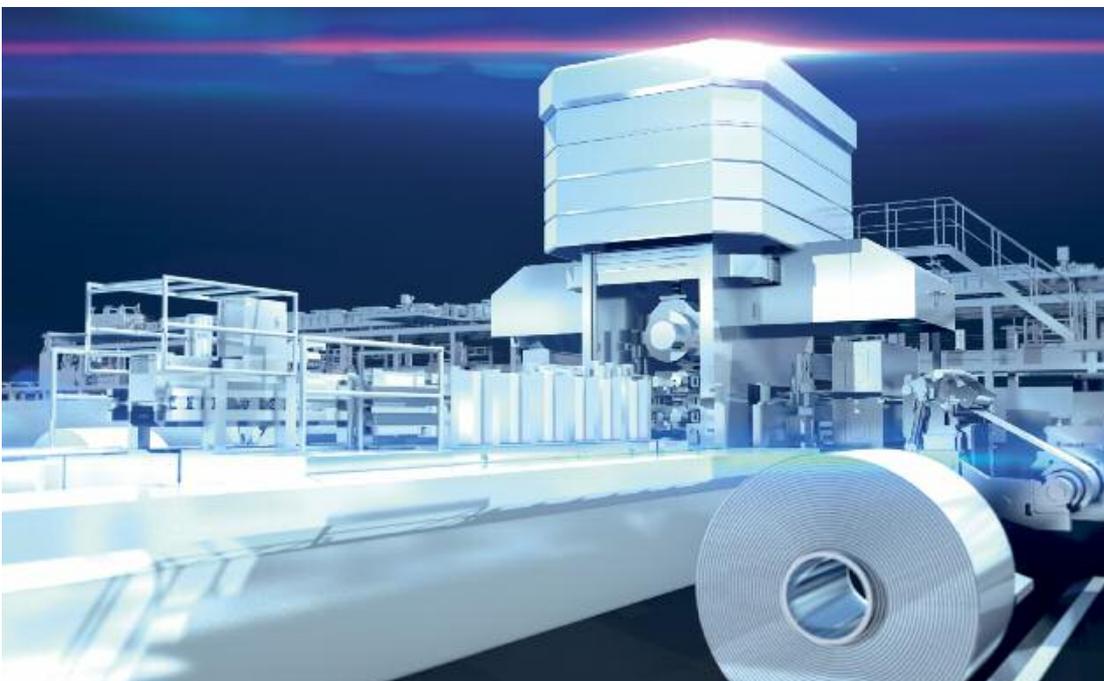
The entry and exit sides of the TM feature technical equipment that is designed for efficient operation and high yield. Special mention should be made of the coil preparation station and pup coil manipulator on the entry side. Strip tension is ensured by the entry-side

Technical data

Temper Mill

Mill type	4-high mill stand
Max. roll force	18,000 kN
Back up roll diameter:	max. 49.21 in (1,250 mm) min. 45.28 in (1,150 mm)
Work roll diameter (1)	max. 25.59 in (650 mm) min. 23.62 in (600 mm)
Work roll diameter (2)	max. 17.72 in (450 mm) min. 15.75 in (400 mm)
Cold strip dimensions:	
Strip width	78 in – 36 in (1,881 – 914 mm)
Exit strip thickness	0.1 in – 0.008 in (2.54 – 0.2 mm)
Hot strip dimensions:	
Strip width	84 in (2,134 mm)
Entry strip thickness	0.160 in – 0.047 in (4.00 – 1.2 mm)
Rolling speed:	max. 2,297 ft/min (700 m/min)
Annual capacity	440,000 short tons (400,000 mt)

set of S-rolls. The tension reel on the exit side is provided with a belt wrapper to ensure safe winding of the finished strip.



Color coating line*

The strip to be coated first goes through an extensive surface cleaning section before the surface is pretreated for priming and/or painting.

Multiple roll coaters are designed to be integrated into the color coating line (CCL) to produce pre-painted strip of uniformly high quality.

The coating machines apply the liquid paint on the strip surface by means of roll heads; pick up rolls transfer the coating to the applicator rolls and then to the strip surface. The coating machines are based on a single slide design and are equipped with a state of the art system that provides full, continuous control not only of the position and pressure but also of other coating parameters (such as roll speed), thus allowing a specific primer and/or paint thickness to be evenly applied across the strip surface.

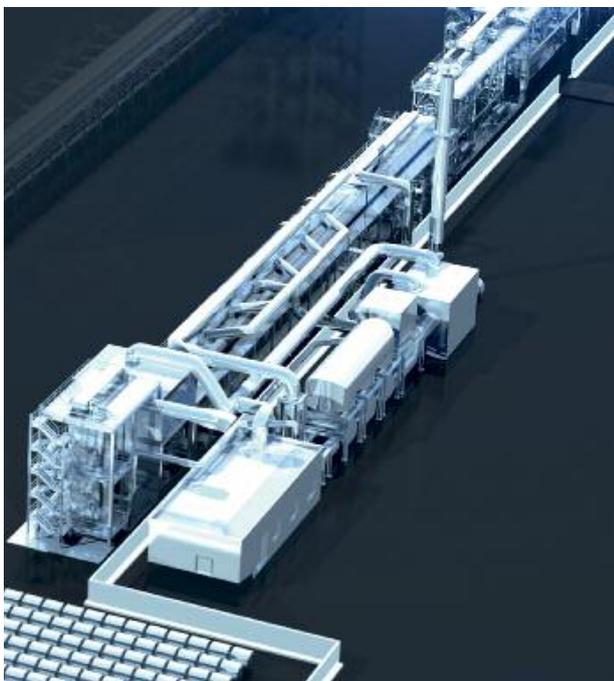
The strip is then dried in a hot air clean oven before being wound into coil form.

Technical data

Color coating line

Annual capacity	250,000 short tons (226,800 mt)
Continuous strip coating - double coat (1) or (2) sides	
Material:	Pickled hot strip Cold rolled steel Galvanized steel Galvalume steel
Strip width:	Maximum: 72 in (1,829 mm) Minimum: 36 in (914 mm)
Strip thickness:	Maximum: 0.076 in (1.93 mm) Minimum: 0.01 in (0.254 mm)
Tensile strength:	Maximum 75,000 psi
Max. coil weight:	64,000 lbs (29,030 kg)
Coatings:	Solvent-based, polyester, siliconized polyester, Kynar coatings

*within SDI scope



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