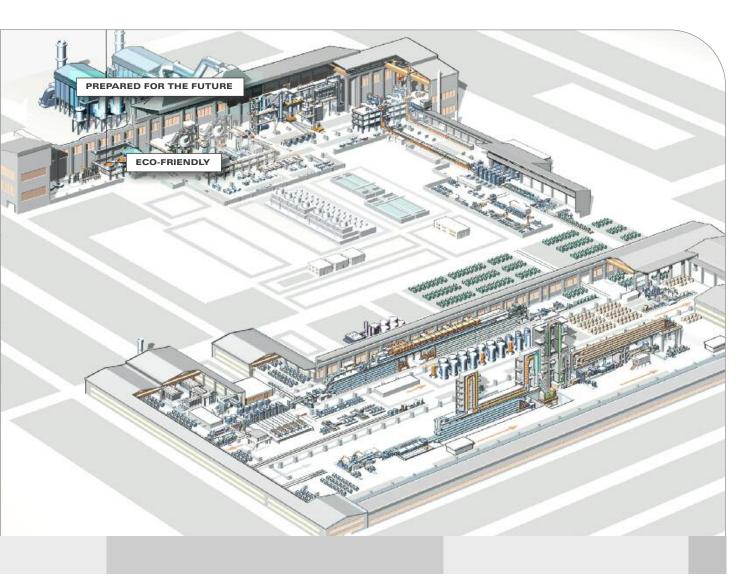




BIG RIVER STEEL

All plants from one source









BIG RIVER STEEL ALL PLANTS FROM ONE SOURCE

Big River Steel located in Osceola, Arkansas, USA on approximately 1,300 acres is one of the country's most modern and environment-friendly steelworks. Applying innovative, clean, and effective processes, the company will produce high-quality steels for the energy, automotive, oil and gas industry from recycled steel scrap.

The plant has an annual capacity of 1.5 million tons of high-grade steel products and specialty steels including:

- Deep Drawing and Extra Deep Drawing Grades (DS, DDS, EDDS, IF)
- Commercial Steel (CQ), Medium and High Carbon Grades
- Structural Steel and COR-TEN Grades
- High Strength Low Alloy Steel (HSLA)
- Advanced High Strength Steel (DP, CP, MS, FB)
- Quenched and Tempered, Abrasion Resistant and Pressure Vessel Grades
- Pipe Grades (API, Sour Gas Resistant (HIC), OCTG)

The capacity of the plant can be further increased to 3.0 million tons in a second construction phase.

As a provider of integrated systems, SMS will supply all units – from the melting plant to the finished steel strip, including all drive and hydraulic components, the entire electrical equipment, the complex automation systems as well as the environmental technologies.

SMS group's supply package includes:

- Gas cleaning plant
- 150-t electric arc furnace, DC type EAF
- High-current system for the DC EAFs, including transformers and Static Var Compensation (SVC)
- = 150 t twin ladle furnace
- = 150 t RH Degasser
- Single-strand CSP® plant (expandable to two strands) with a six-stand rolling mill for a maximum strip width of 1,930 millimeters
- Coupled pickling line/tandem mill, including CVC® plus, hydraulic screwdown, multi-zone cooling, emulsion system and innovative fume extraction system
- Offline skin-pass mill with 18 MN rolling force
- Batch annealing furnaces
- Universal Annealing and Galvanizing Line (CAL/CGL), including a Drever furnace, an ultra-fast cooling system for high-strength dual-phase grades and a FOEN air-knife system and an inline skin-pass mill
- X-Pact® electrical and automation systems for the complete plant complex, including flexible production planning systems, technological process models, highly dynamic technological control systems and sequence controls, integrated and user friendly operation and visualization systems, technological measuring devices and sensors, drives and power supply.



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 strict environment protection and work safety regulations at the Osceola location, the company must reliably prevent fugitive emissions. That requires almost complete interception of the strongly varying gas volumes in all operating phases of the steelworks.

Most of the dust-contaminated exhaust gas is trapped at the Electric Arc Furnace (EAF) itself and cooled from approx. 1,400 °C to less than 600 °C in an indirectly cooled duct section. This consists of a swivel elbow or movable elbow, a combustion chamber where the post combustion of the CO-laden off gas takes place and coarse-particles can settle and a subsequent hot gas duct.

Other dust-laden gas flows from the EAF are securely captured by the canopy. Furthermore, both work positions of the ladle furnace (LF) and two ladle treatment stands (LTS) are connected downstream of the RH Degasser.

Yet there is even more that the gas cleaning plant can do to reduce dust emissions from the steelmaking facility. It is also designed for the operation of extractor hoods in the area of the break-out stands for the EAF bottom vessel, ladles, and tundish.

Speed-controlled radial fans help channel the gases generated at various points in the steelworks through a branched pipe system to a bag filter with pulse-jet technology. Prior to that, a mixer equalizes the gas temperature and separates out hot particles. Both these processes protect the filter.

The filtered-out dust is pneumatically transported to a silo where it is interim-stored before loading into tank wagons.

The entire gas cleaning plant is fully automated and integrated in the X-Pact® solution. All extraction points are controlled as required, ensuring low-emission, energy-efficient operation.

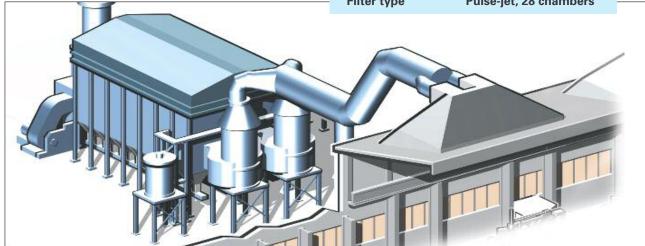
Technical details

Nominal capacity

2,300,000 Am3/h

Filter type

Pulse-jet, 28 chambers



STEELMAKING PLANT

2

Electric Arc Furnace

3

Twin Ladle Furnace

The Big River meltshop is designed for achieving high productivity of high quality steel grades. Included here are interstitial-free, high-strength low-alloy, advanced high-strength steel as well as non-grain-oriented electrical steels.

The DC electric arc furnace produces heats at the rate of almost 220 tons per hour. Plus there is a twin-station ladle furnace that offers the flexibility to treat two heats simultaneously. This proven steelmaking technology ensures that only the highest-quality steel will reach the CSP® thin slab caster.

Technical details

Meltshop

EAF heat weight nominal 150 t

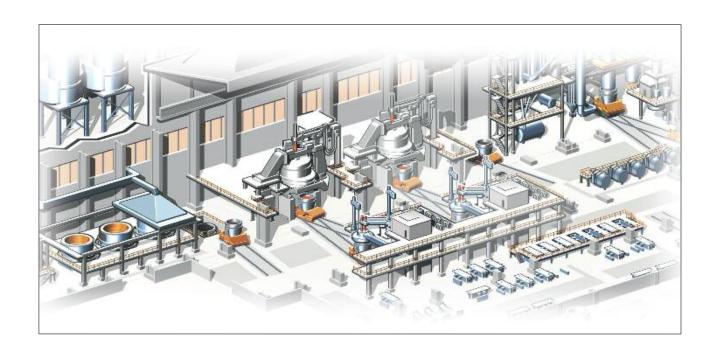
EAF type DC,EBT with patented pin-type anode

EAF power max. 160 MW

LF type Twin-station with joint electrodes

LF power system 25/28 MVA

The complete high current power supply including transformers, rectifiers and compensation and filtering equipment was supplied by SMS. The close interaction of all steel plant technological process models together with the level 3 system ensure an innovative, optimized and flexible production process.





RH DEGASSER

The RH Degasser is executed with two ladle transfer cars on a V-track and a fast vessel exchange type with two vessel stand-by positions. Between the two vessel stand-by positions there is a treatment position where the vacuum vessel is connected to the gas cooler via the vessel top part. As soon as the shop crane has picked up the first ladle in order to transfer it to the CSP® casting machine, the second ladle car transfers the second ladle to the treatment position. So, by using two ladle cars, it's possible to reduce the cycle time of the RH degasser.

Also to be installed in the plant is one set of steam ejector vacuum pumps for the RH vacuum refining facilities. The vacuum vessel top part receives a TOP-lance to blow oxygen for forced decarburization or chemical heating during vacuum treatment or to burn gas with oxygen to keep the vessel refractory at operating temperature during non-vacuum treatment.

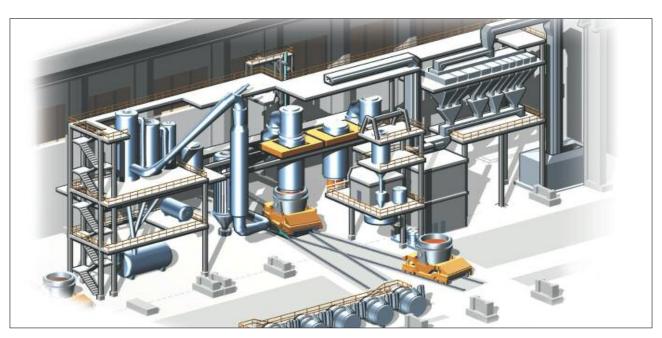
The measuring and control equipment takes care of monitoring, controlling and regulating all process sequences. It's equipped with all the elements required to ensure proper running and monitoring of the plant.

As far as possible, plant control, i.e. operation and supervision of the plant equipment, is carried out from a central control room via a basic automation system.

There is not only a basic automation system but also a process computer. This provides heat and process related information, collects data for a heat report, tracks and monitors the physical-chemical state of the heat, and finally determines set point data of types and amounts of additions as well as the duration of the time-dependent treatment steps. That measurably improves uniformity in treatment practice, which results in increased reproducibility of the required steel grade specification, irrespective of the specific influences of the different plant operators.

Technical details

Cycle time approx. 30 - 50 min Suction capacity 650 kg/h at 0.67 mbar TOP-lance heating speed \geq 50 °C/h



CSP® PLANT

Initially, in its first development stage, the CSP® plant will consist of a CSP® thin slab caster, a CSP® tunnel furnace as well as a CSP® rolling mill with six mill stands and one downcoiler. SMS will not only supply the entire mechanical equipment – complete with the CSP® tunnel furnace – but also the X-Pact® electrics and automation. Included here are the Level-2 systems with all process models as well as the Level-1 automation featuring the technological controls for all units, from the caster to the coil transport system.

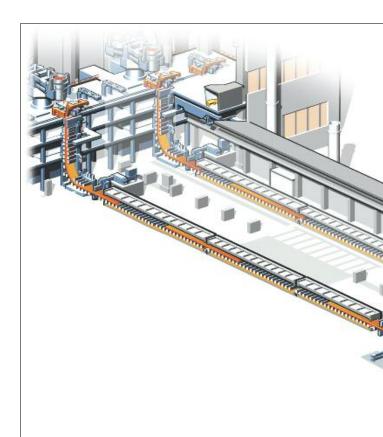
Following completion of this construction phase, the mill will produce 1.5 million tons of hot strips. Next in line will be a downstream pickling which will process most of the hot strips to produce premium cold strip. Further quantities will be sold as pickled and oiled strip. The rest, or two thirds of production, will go directly to customers as untreated strip. Already planned is a later phase that will expand production capacity into a second casting stream. Then the facility will be able to roll out 3 million tons of steel per year.

The CSP® plant is capable of producing strips with thickness ranging between 1.55 - 25.4 millimeters. Equally impressive is the strip width of up to 1,930 millimeters, which means Big River Steel owns the world's widest CSP® plant. It features a Mold Monitoring System (MMS) that transparently maps the casting conditions inside the mold, preventing breakouts. Also installed is Liquid Core Reduction (LCR plus) to variably adjust the slab thickness between 85 and 55 millimeters for an optimized throughput rate. The Dynamic Solidification Control model (DSC) ensures an optimized cooling and together with the soft reduction results in better slab quality.

The caster pendulum shear with a nominal shearing force of max. 12,500 kN is also the strongest pendulum shear ever built for a CSP® plant. A unique descaler is installed between the caster and the pendulum shear.

A roller hearth furnace forms a kinematic and technological link between the continuous caster and the rolling mill, making it a central element in the CSP® plant. The first furnace zone sets the required thin strip temperature for the rolling process. It uses environment-friendly ultra-low NOx burners for this process. To save energy, the combustion air is preheated with waste heat from the furnace recovered by recuperators. The downstream homogenizing zone maintains the temperature and equalizes it across the length and cross-section of the slab to ensure an even temperature distribution. This facilitates the rolling process and contributes to a high-quality final product.

Already in place are plans for producing sophisticated products that cater to the demands of the growing





market - products such as pipe grades for pipelines, AHSS grades, and especially silicon steels for electrical sheet. That's why the CSP® tunnel furnace is designed from the start for slab temperatures of more than 1,200 °C. This includes water-cooled furnace rollers with fireproof insulation made of aluminum silicate wool. So higher temperatures are possible at low energy losses via the roller cooling water.

That's where a newly developed process comes in to minimize the contact pressure between roll carrier rings and slab for high surface quality of the end product.

Optionally, a future expansion stage can substitute the final section of the tunnel furnace with a multiplemodule induction heating system. This would make it possible to increase the slab temperature. That offers advantages for various steel grades

The mill automation includes not only the usual models, but also a recrystallization model and a material property model to predict the material characteristics. Arranged below and above the run out table is the reinforced laminar strip cooling system which is equipped with the latest version of the 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 a very good cold strip flatness is ensured. Arranged underneath floor level at the end of the runout table, the downcoiler with a mandrel drive of 1,000 kW is the strongest down-coiler ever built for a CSP® plant.

| | | _ | |
|------------------|-------------------------|-----------------------------|----------------------------------|
| Caster | | Furnace | |
| Ladle capacity | 150 t | Max. furnace temperatu | re 1,250 °C |
| Tundish capacity | 38 t | Slab exit temperature | 1,050 - 1,220 °C |
| Slab thickness | 85 - 55 mm via LCR plus | Furnace length | 291 m |
| Slab width | 900 - 1,930 mm | Rollers | water cooled with |
| ^ | | energy sav | ing fiber insulation |
| | _ | No. of burners | 232 extra low NOx |
| | | Mill | |
| | | | |
| | | Strip width | 900 - 1,930 mm |
| | | Strip width Strip thickness | 900 - 1,930 mm 1.55 - 25.4 mm |
| | | | |
| | | Strip thickness | 1.55 - 25.4 mm max. 40.3 t |

PICKLING LINE/ TANDEM COLD MILL

(PLTCM)

The pickling tandem mill features an X-Pro® laser welder, a scale breaker, a turbulence pickling section, and a tandem mill. Most of the production volume will be further processed within the plant, however also included here is an DUMA-BANDZINK oiling machine to enable the customer to manufacture pickled and oiled material.

Key to the continuous process is an X-Pro® laser welder for precise and rapid welding of difficult-to-weld, high-alloy strip. Reliable welding means that the strip travels safely through the process and can be rolled without problems. It ensures that the line can handle even high-carbon or high-silicon grades. Next in line is the turbulence pickling section consisting of 27-meterlong plastic tanks, each with their own cycle.

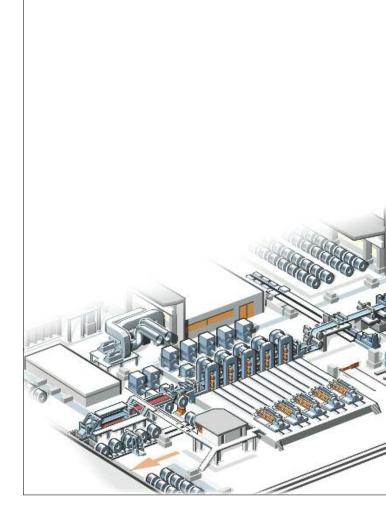
The system stands out for its high pickling performance, low energy and acid consumption, and low maintenance and operating costs over a long service life. To achieve optimal pickling results with minimal energy input, operators can actively influence and optimally adjust all the main parameters.

The tandem mill processes a very wide range of materials that each come with their own, high requirements. It comprises five four-high mill stands. State-of-the-art measuring systems, regulation strategies, and control elements ensure the necessary strip quality. Included here is our X-Shape flatness measuring roller. This solution stands out for its robustness with a closed roller surface, precision flatness measuring, and reliable optical, wear-free signal transmission.

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

There are two tension coilers in the exit area for continuous coiling of the rolled strip. Belt wrappers help protect the valuable finished strip from damage. Also featured in the tandem line is Rotary Inspect. This is today's most modern inline strip inspection line. It ensures reliable, prompt, and ergonomically optimized evaluation of the strip surface quality.

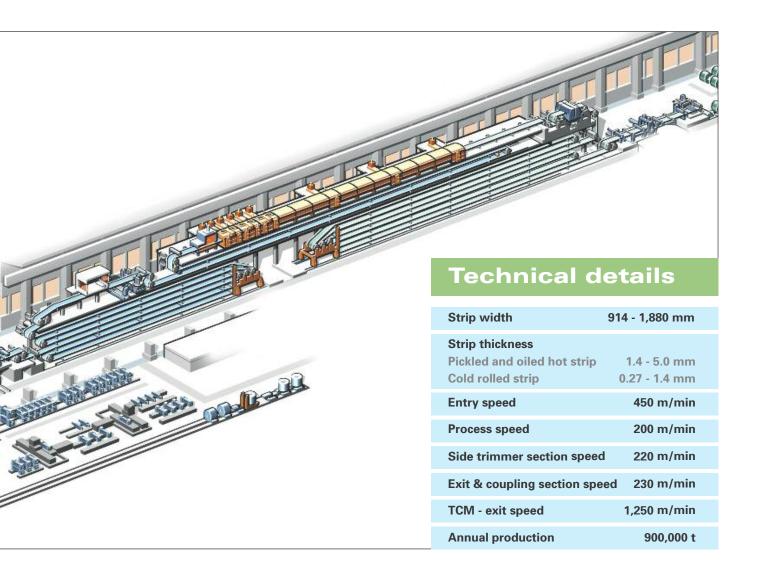
Yet there is even more that makes the tandem line operator-friendly as well as reducing non-productive





times. Take for instance the fully automatic work roll changer, which comes complete with an automatic coupling system for all media.

When it comes to green technology and maintenance-friendliness, the tandem line also sets new standards. 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. Our customer benefits doubly from the latest-generation fume extractor. It acts early in the process, controlling the air flow to reduce fume generation at source. That ensures Big River Steel complies 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.



OFFLINE SKIN-PASS MILL

(SPM)

The single-stand 4-high Skin-Pass Mill (SPM) is designed for a capacity of more than 400,000 tons per year. As part of the discontinuous process route, the SPM is arranged behind the Batch Annealing Furnace (BAF). Its main function is to provide the annealed carbon and a portion of Non-Grain-Oriented (NGO) silicon strips with the material properties required for downstream processing.

Included here are harmonizing the yield points as well as setting the strip roughness and flatness. To ensure strip quality, the quarto comes with both Hydraulic Gap Control (HGC) and Strip blow-off system on the exit side. It can be operated with two different work roll diameter ranges (650/600 mm and 450/400 mm), 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 requirements.

The most remarkable feature of the mill is the high roll force of 18 MN. That's why very high degrees of skin passing of up to 8.5 percent are possible. The high

rolling force is required especially for skin passing of silicon steel grades. The maximum rolling speed is 1,000 meter per minute. The skin pass mill operates with a wet skin passing system. In the entry as well as in the exit section there are bridle rolls installed to ensure strip tensions.

Additionally included in the main entry-side equipment is a pay-off reel with strip centering device, coil preparation station, and pup coil removal system. To ensure safe strip winding and protection of the finished strip surfaces, the exit side tension reel features a belt wrapper. Last but not least, the exit side equipment is completed by an oiling machine plus a coil car for removing the finished coils.

Technical details

4-high mill stand

18 MN

Mill type

Max. roll force

| | maxi ron roros | 10 11111 | | |
|---|--|---------------------------------|--|--|
| | Elongation | up to 8.5 % | | |
| | Backup roll diameter | max. 1,250 mm, min. 1,150 mm | | |
| | Work roll diameter | 650/600 mm, or 450/400 mm | | |
| | Strip width max. 1,880 mm, min. 914 mm | | | |
| | Strip thickness max. 1.4 mm, min. 0.28 mm | | | |
| | Rolling speed | max. 1,000 m/min | | |
| 3 | Annual capacity | 400,000 t | | |
| | | | | |
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BATCH ANNEALING FURNACES

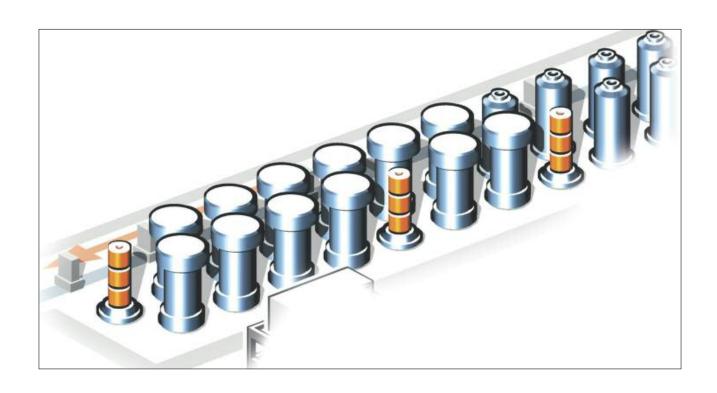
(BAF)

Apart from the annealing and hot-dip galvanizing line, Batch Annealing Furnaces (BAF) for cold strip processing will also be installed. This is where the cold strip coils are annealed and cooled in batches. That means several coils can be processed simultaneously at a maximum stacking height of 6.4 meters, a top stacking weight of 140 tons, and a maximum coil outer diameter of 2,000 millimeters.

Depending on the material, treatment takes between 42 and 55 hours. Newly installed will be a total of 24 annealing bases with 13 heating covers and 11 cooling covers so that more than 400,000 tons of steel can be treated per year. Carbon steels (CQ, DQ, EDDQ, HSLA) and Non-Grain-Oriented silicon steels are treated in a 100 percent hydrogen atmosphere. To conform to strict US environmental standards, the system uses special low-NOx technology. The batches are cooled with air and water.

Technical details

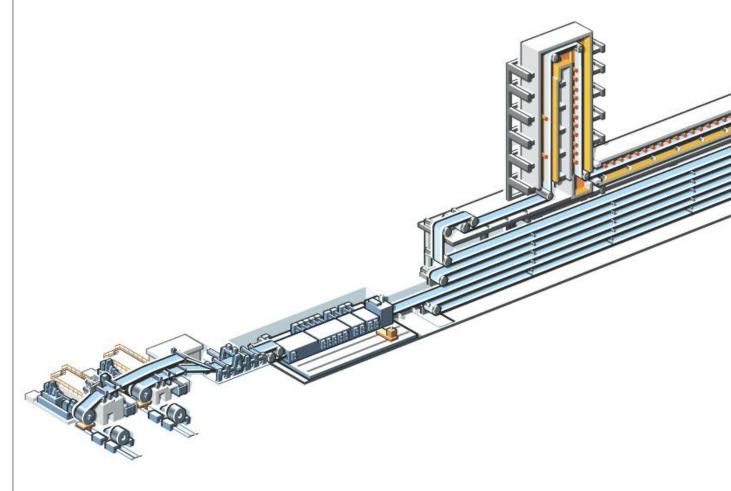
| No. of bases | 24 |
|-----------------------|----------------------------------|
| No. of heating covers | 13 |
| No. of cooling covers | 11 |
| Product mix | Carbon steel and NGO material |
| Max. stacking height | 6,400 mm |
| Max. stacking weight | 140 t |



UNIVERSAL ANNEALING AND GA (CAL/CGL)

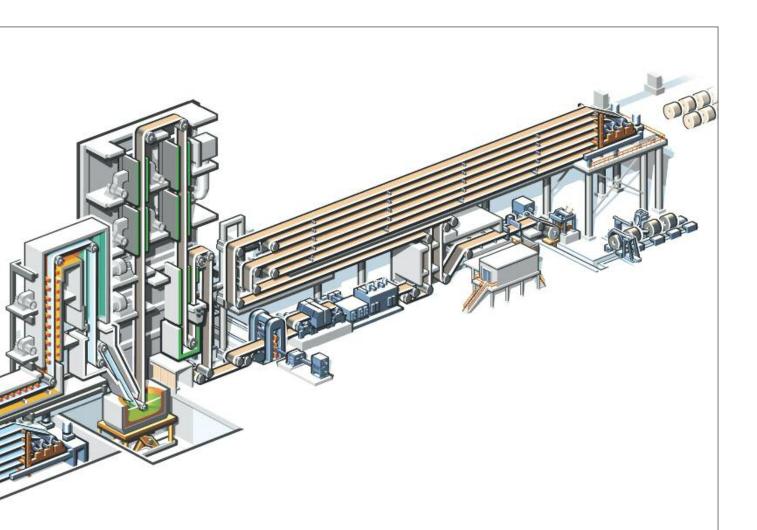
The continuous annealing and hot-dip galvanizing line is equipped with a cleaning section, a Drever furnace, a FOEN air-knife system, a skin-passing mill, a tension leveler, and a spray passivation section. It's possible to lower the zinc pot into a parking position with a hydraulic platform. Installation of a cold guide roll then means the manufacturer can use the line as a pure annealing line. Unique here is the innovative design because it allows for the production of two different products (annealed or galvanized) depending on current market demand. That makes it possible to respond to changes on the market and attain maximum costefficiency.

The strip is heated in the furnace by direct firing and radiant tubes. What particularly stands out is the ultrafast cooling system. It cools the strip rapidly, so that the plant can produce high-strength automotive grades. Furthermore, the eco-friendly furnace comes with several energy-recovery features plus an additional NOx treatment phase. Plus there is a downstream FOEN air knife that removes the excess zinc evenly from the entire strip width and ensures high-precision coat thicknesses of between 30 and 235 g/m² per side. Next in line is finishing in a skin-passing mill, a leveler, a passivation section, and a DUMA BANDZINK-oiling machine. Finally, quality is checked continuously at the inspection station.





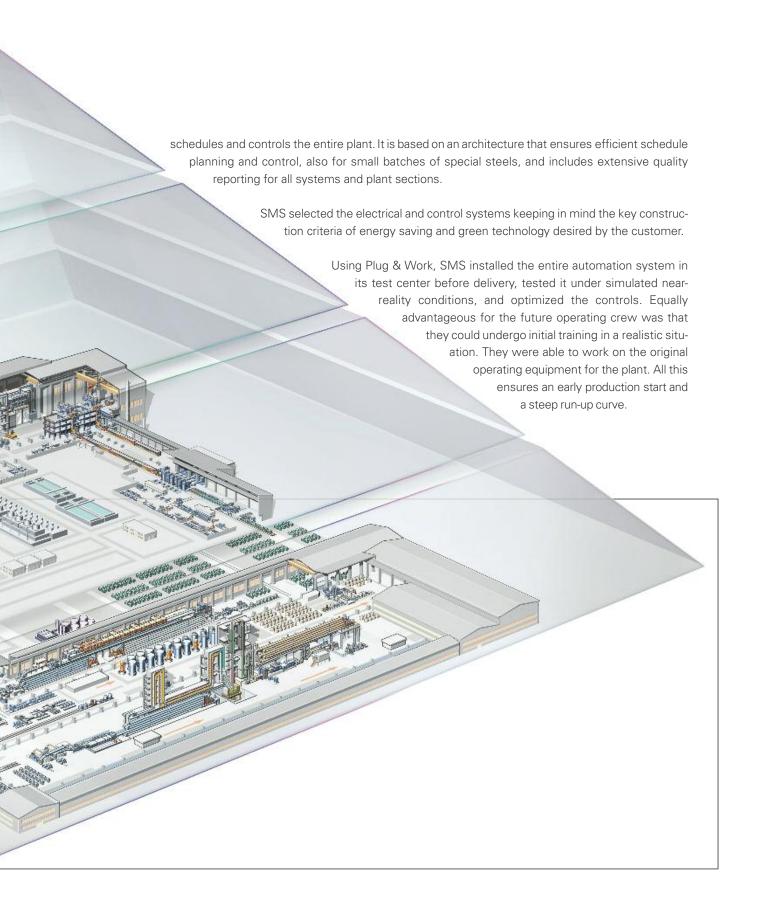
LVANIZING LINE



| 900 - 1,850 mm |
|----------------|
| 0.36 - 3.00 mm |
| 220 m/min |
| 150 m/min |
| 220 m/min |
| 476,457 t |
| |







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