PRIMETALS
TECHNOLOGIES

PICKLING & TANDEM COLD MILL

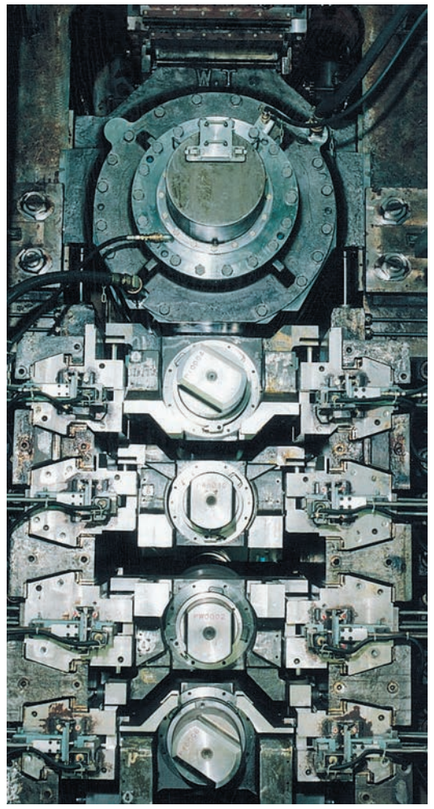
CONTINUOUS PL-TCM WITH CUTTING EDGE TECHNOLOGIES

Over the past 50 years, Mitsubishi Heavy Industries, Ltd. and Hitachi, Ltd. have individually worked with the world steel industry supplying advanced technologies, increasing production, and improving quality. In the face of increased global competition, the steel industry divisions of Mitsubishi Heavy Industries and Hitachi joined together on October 2, 2000 in a joint venture to provide superior service and products.

Primetals Technologies Japan, Ltd. has supplied more than 50 plants with continuous pickling and tandem cold mill coupled lines (PL-TCM*) since 1971. Based on the rich experience, we offer state-of-the-art technologies to satisfy many customer needs.
The continuous PL-TCM increases the quality of products, conserves energy, reduces labor cost, boosts output rates, achieves greater efficiency and raises overall productivity. Our key technologies, high efficiency pickling tank, FWC side trimmer, 6Hi UCM-MILL, HYROP-F and Carrousel Tension Reel, support production of the latest advanced steels such as IF, TRIP, DP and so on.

We have learned not only from successful experiences, but also from many failures in the improvement of our technologies.
We analyze our experience and listen to our customers before charting the next course of advanced technology development and product reliability improvement. Our goal is to develop the technologies for steel industry through the customers and contribute our technologies for the benefit of society.

*PL-TCM...Coupled Continuous Pickling Line and Tandem Cold Mill



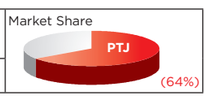
CONTINUOUS TANDEM COLD MILLS newly installed in the world after 1980

No.	User	Mill Type	Products	Start-up
1	Nippon Steel (Hirohata)		Sheet	1982
2	Nisshin Steel (Sakai)		Galva.	1985
3	Kawasaki Steel (Mizushima)		Sheet	1986
4	NKK (Fukuyama)		Sheet	1987
5	POSCO (Pohang No.2)		Sheet	1987/ 2003/ 2007
6	UPI (USA)		Tin& Sheet	1988
7	I/N Tek (USA)		Sheet	1989
8	POSCO (Kwangyang No.1)		Sheet	1988/ 2006
9	POSCO (Kwangyang No.2)		Sheet	1990/ 2009
10	Nippon Steel (Yawata)		Galva& Sheet	1990
11	POSCO (Kwangyang No.3)		Tin& Sheet	1991
12	DOFASCO (Canada)		Tin& Sheet	1992
13	China Steel (Taiwan No.2PLCM)		Sheet	1992/ 2007
14	Sumitomo Metal (Kashima No.2)		Galva& Sheet	1993
15	TON YI (Taiwan)		Tin& Sheet	1995
16	ERDEMIR (Turkey)		Sheet	1995
17	NKK/TCRSS (Thailand)		Galva& Sheet	1997
18	POSCO (Kwangyang No.4)		Sheet	1997
19	Hyundai Pipe (Korea)		Galva	1998
20	SUS/NSC (Thailand)		Tin	1998
21	Baoshan Steel (No.3)		Sheet	2000
22	TATA Steel (India)		Galva& Sheet	2000
23	Nisshin Steel (Toyo)		Galva& Sheet	2000
24	Maanshan Steel (China No.1)		Galva& Sheet	2004
25	Baoshan Steel (No.4)		Galva& Sheet	2005
26	Lianyuan Steel (China)		Galva& Sheet	2005/ 2010
27	Benxi Steel (China)		Galva& Sheet	2006
28	Wuhan Steel (China)		Silicon& Sheet	2006
29	Maanshan Steel (China No.2)		Galva& Sheet	2007
30	Union Steel (Korea)		Galva& Sheet	2007
31	Shougang Jingtang Steel (China)		Galva & Sheet	2009
32	Jiuquan Steel (China)		Galva & Sheet	2009
33	POSCO Vietnam (Vietnam)		Galva & Sheet	2009
34	Baoshan Steel (BST)		Sheet	2010
35	SeverStal (USA)		Galva & Sheet	2011
36	Guangzhou JFE (China)		Galva & Sheet	2011
37	Shougan Qian'an (China)		Sheet	2011
38	China Steel (Taiwan No.3PLCM)		Galva & Sheet	2011
39	Shougang Jingtang Steel (China No.3)		Tin & Sheet	2013
40	Wuhan Steel (China)		Tin	2013
41	Panzhihua Steel (China)		Galva & Sheet	2013
42	HYNDAI HYSCO (Koria)		Galva & Sheet	2013
43	POSCO Maharashtra (India)		Galva & Sheet	2013
44	Ternium (Mexico)		Galva & Sheet	2013
45	Shanxi Taigang Stainless Steel (China)		Silicon& Sheet	2013
46	Baoshan Steel (Zhanjiang, China)		Galva& Sheet	2016
47	BaoTou Steel (China No.2)		Galva& Sheet	2015
48	Guangxi Steel(Fang cheng gang, China)		Galva& Sheet	2016
49	Tosyali Toyo Steel (Osmaniye, Turkey)		Tin& Sheet	2016
50	Baoshan Steel (Zhanjiang No.2, China)		Silicon& Sheet	2017

Notes ● : Shiftable roll ● : Future plan

Supplied by PTJ	Supplied by Others	Total
50plants (64%)	28plants (36%)	78plants (100%)

Market Share



Above Primetals Technologies Japan, Ltd. supply of 50 plants since 1980 will mark 64% on the world share of the major Continuous TCM during this period

ADVANCED TECHNIQUES FOR CONTINUOUS PL-TCM

Entry Coil Handling

Main Equipment
- Pay off reel
- Auto strip head end opening
- Processor leveller
- Laser welder, Flash butt welder

Features
- Stable coil handling
- Confident strip threading

Mechanical Scale Breaker

Main Equipment
- Tension Leveller (Dry type or Wet type)

Features
- Reduction of acid consumption
- Reduction of pickling time
- Smooth threading
- High scale removing

Pickling Tank

Main Equipment
- Pickling tank (Jet type or *i*Box® type)
- Rinse tank & dryer

Features
- Stable operation
- Energy saving

Side Trimmer & scrap Chopper

Main Equipment
- High stiffness Side trimmer (Turret Type)
- FWC Side trimmer
- Scrap chopper

Features
- Fine trimmed edge
- Stable & quick width changing
- Quick knife changing

Dual CPC

Main Equipment
- Rough CPC unit
- Fine CPC unit
- Mill entry bridle
- THREE ROLL BRIDLE unit

Features
- High accuracy strip centering
- Improvement of winding profile

Carrousel Tension Reel

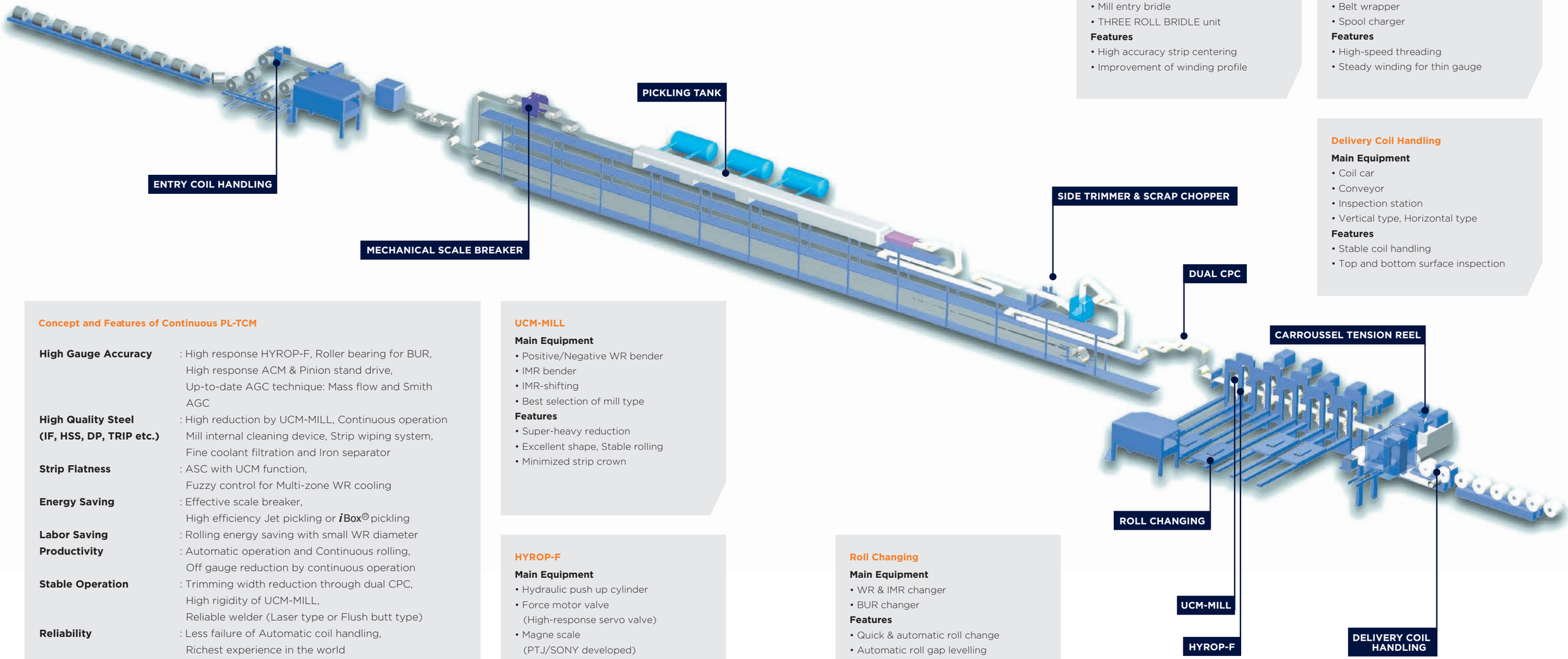
Main Equipment
- Flying shear (Drum type)
- Carrousel reel
- Belt wrapper
- Spool charger

Features
- High-speed threading
- Steady winding for thin gauge

Delivery Coil Handling

Main Equipment
- Coil car
- Conveyor
- Inspection station
- Vertical type, Horizontal type

Features
- Stable coil handling
- Top and bottom surface inspection



Concept and Features of Continuous PL-TCM

High Gauge Accuracy	: High response HYROP-F, Roller bearing for BUR, High response ACM & Pinion stand drive, Up-to-date AGC technique: Mass flow and Smith AGC
High Quality Steel (IF, HSS, DP, TRIP etc.)	: High reduction by UCM-MILL, Continuous operation Mill internal cleaning device, Strip wiping system, Fine coolant filtration and Iron separator
Strip Flatness	: ASC with UCM function, Fuzzy control for Multi-zone WR cooling
Energy Saving	: Effective scale breaker, High efficiency Jet pickling or *i*Box® pickling
Labor Saving	: Rolling energy saving with small WR diameter
Productivity	: Automatic operation and Continuous rolling, Off gauge reduction by continuous operation
Stable Operation	: Trimming width reduction through dual CPC, High rigidity of UCM-MILL, Reliable welder (Laser type or Flush butt type)
Reliability	: Less failure of Automatic coil handling, Richest experience in the world

UCM-MILL

Main Equipment
- Positive/Negative WR bender
- IMR bender
- IMR-shifting
- Best selection of mill type

Features
- Super-heavy reduction
- Excellent shape, Stable rolling
- Minimized strip crown

HYROP-F

Main Equipment
- Hydraulic push up cylinder
- Force motor valve (High-response servo valve)
- Magne scale (PTJ/SONY developed)

Features
- Quick response (20Hz)
- High accuracy (±1μm)
- Long lasting servo valves (2-5years)
- Easy oil maintenance (NAS Class 8-9)

Roll Changing

Main Equipment
- WR & IMR changer
- BUR changer

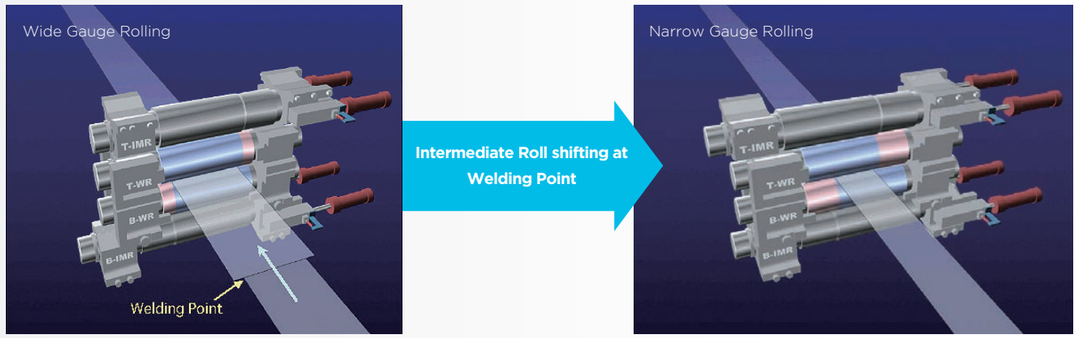
Features
- Quick & automatic roll change
- Automatic roll gap levelling

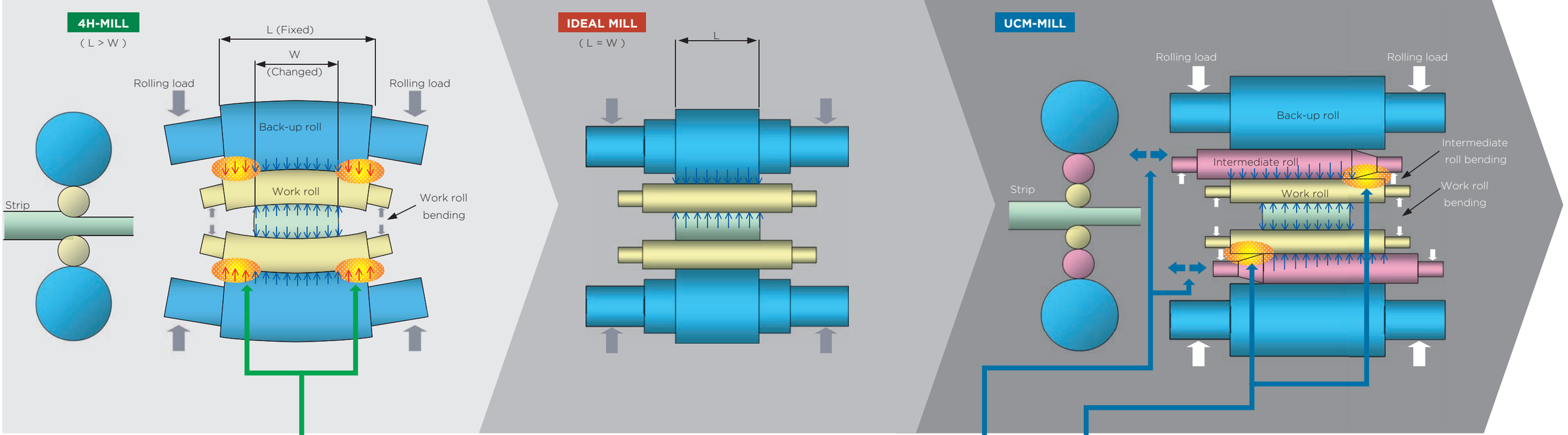
UCM-MILL THE SIMPLE APPROACH TO BEST PERFORMANCE

UCM-MILLs function on a very simple idea.
In order to correct the flatness and crown (profile) problems caused by work roll deflection in conventional mills, the UCM-MILL as shown here, uses shiftable intermediate rolls to sharply reduce the undesirable contact area that is responsible for work roll deflection.
UCM-MILL gives mill operators greater flatness control and simple operation.

Flying Gauge (Width) Change for Continuous Rolling

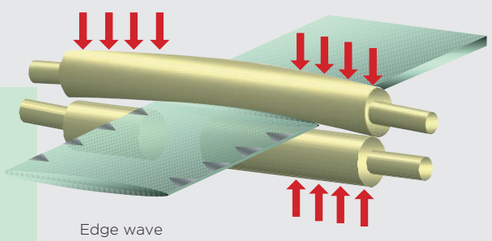
Simple Intermediate Roll Shift maintains the best performance at the various conditions of the strip.
UCM-MILL achieves ever stable rolling, that reduces the strip breakage and extends the roll change interval.





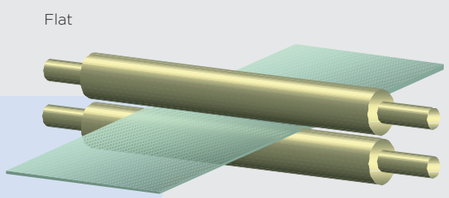
Undesirable contact area

When work roll deflection is increased:
1. Some kinds of Initial crowns are necessary for work rolls.
2. Work roll inventory is high.
3. Reduction of work roll diameter is difficult.
4. Work roll bending is ineffective.



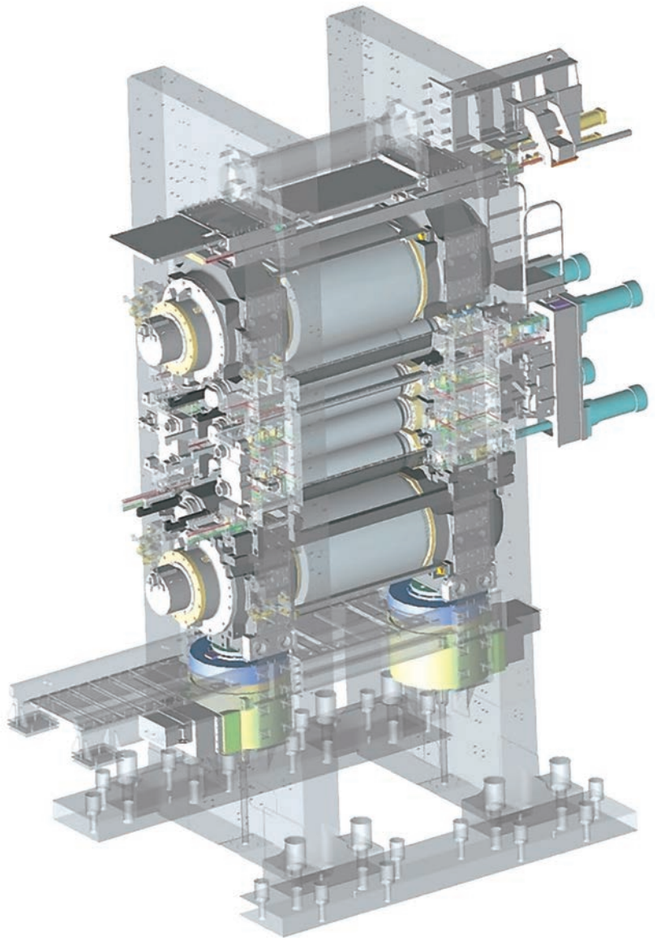
IMR Shifting

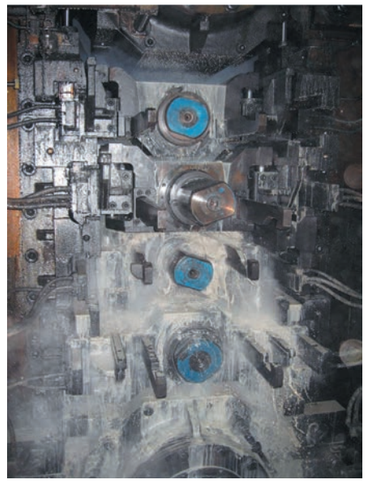
Undesirable contact area is eliminated → UCM-MILL



Work roll deflection is reduced
1. **Straight** Work, Intermediate and Back-up rolls can be used. → **Roll inventory is improved.**
2. Work roll diameter can be reduced. → **Heavy reduction is possible.**
3. Work roll and intermediate roll bending are effective. → **Excellent shape control capability is achieved.**
4. Edge drop is reduced. → **Yield is increased.**

TANDEM COLD MILL FOR CONTINUOUS ROLLING





Tandem Cold MILL

Application of the UCM-MILL makes possible to roll all products with straight rolls, which will allow to get rapid start up. The operators derives most stable rolling and shape controllability. Thanks to the horizontal rigidity created by shifting of intermediate roll, the user can control strip thickness deviation without jeopardizing the shape of the strip.

The mill is equipped with high response Hydraulic Roll Position Device (HYROP-F), Laser Doppler type speed measuring device and X-ray type thickness gauge meters. By using these equipment, high performance up-to-date Automatic Gauge Control (AGC) system, which includes the mass flow control, can obtain the higher standard of the finished thickness. At the exit of the mill, a modern designed shape measuring sensor and Automatic Shape Control (ASC) system is installed. They can guarantee the required flatness of finished coil and the qualified products can be produced.

Feature of Mill Type

Mill Type	WR Bender	IMR Bender	WR Shift	IMR Shift
HCM	✓			✓
UCM	✓	✓		✓
HCMW	✓		✓	✓
UCMW	✓	✓	✓	✓

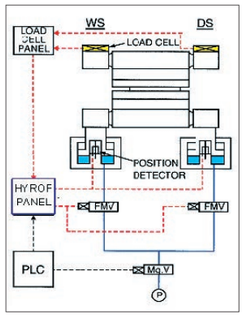
HYROP-F System

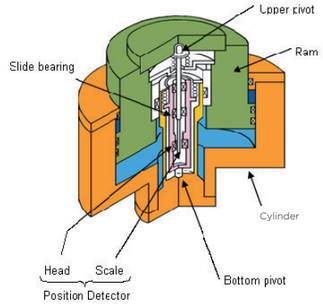
HYROP-F System consists of

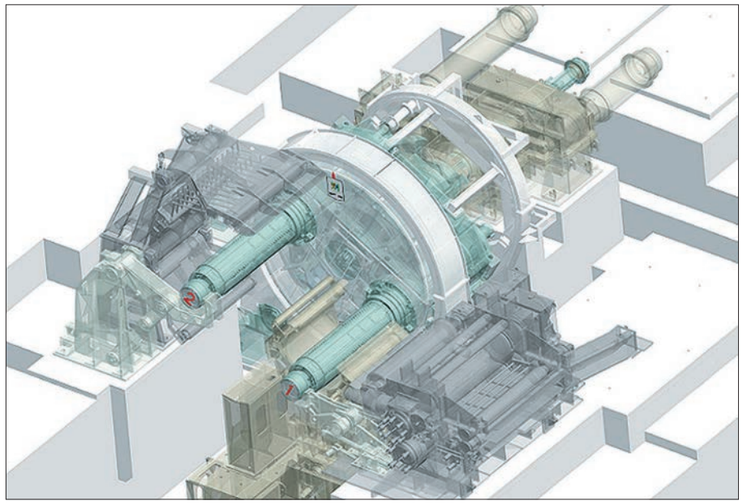
1) Direct operated servo valve, FMV (Force Motor Valve), specially developed for rolling mill
2) Hydraulic push up cylinder with bulit-in precise position detector
3) Well arranged hydraulic piping for high response
4) Exclusively designed Control System

By the combination of each component, high performance and reliable roll load system is realized.

HYROP System component





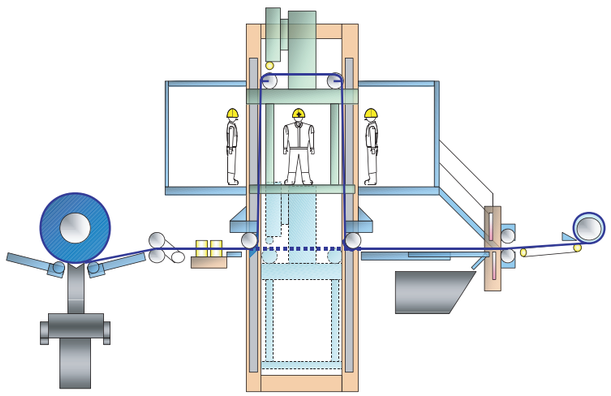


Delivery Strip Handling Device

The endless rolled strip is divided by the high speed ROTARY SHEAR and re-wound into coils.
The CARROUSEL type TENSION REEL configuration is applied to support continuous coil changeover during continuous rolling in mill section. Coil changeover operation is done by an automatic control blocks for reliability and ease of the operation.

Inspection Station

To produce high surface quality strip, high efficiency inspection station at the TCM bottom end is essential. The vertical elevator type strip and other various types of inspection station was developed for efficient two-sides inspection.



ADVANCED DESCALING SYSTEM

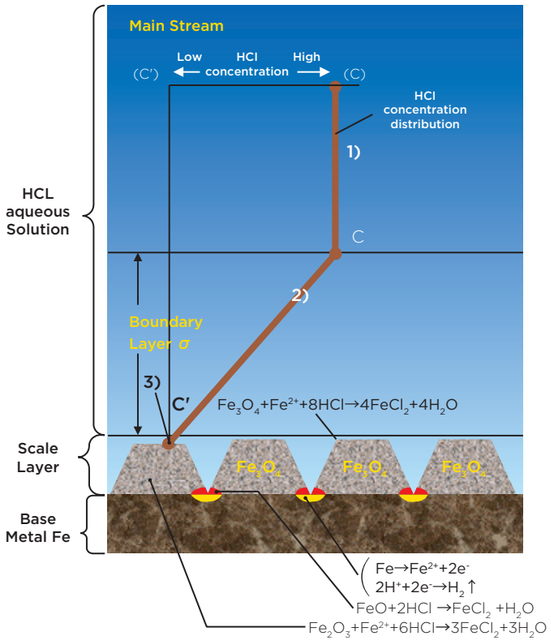


Fig. 1 Pickling reaction and HCl concentration distribution

1. Introduction

In the fields of automobiles and electrical home appliances, which are the principal consumers of cold-rolled steel strip, recently, there has been increasing demand for ultra-low carbon steel or high-tensile steel with excellent processability from the viewpoint of quality and productivity. To meet this trend, steelmakers are expanding the production of ultra-low carbon steel or high-tensile steel, but since this steel requires pickling time (descaling time) of about two to three times that of general steel in the conventional deep-bath pickling tank, operations are slowed by 1/3 to 1/2 (verify operations are reduced BY 1/3 to 1/2) compared to general steel production. As a result, production output has not increased.

To solve this problem, in replacing the conventional pickling method, it is necessary to develop a new method that effectively shortens the pickling time and is capable of treating strips at high-speed. To meet this requirement, Primetals Technologies Japan, Ltd. (PTJ) developed a new pickling system called " ***i***Box® ".

2. Pickling theory

2.1 Dominant factors in pickling section

Reaction theory is explained below by means of a typical case of pickling in HCl aqueous solution.

The pickling reaction may be considered to be composed of the following three processes as shown in Fig.1.

1) Supply of HCl from the mainstream of HCl aqueous solution in the pickling tank into the boundary layer.

2) Supply of HCl onto the scale surface and into cracks through the boundary layer by molecular diffusion.

3) Chemical reaction at the scale interface.

Comparing the second and the third process, the reaction rate is sufficiently fast, the mass transfer at the boundary layer in the second process mainly dominates the pickling reaction.

2.2 Enhancing the pickling reaction

It is the mass diffusion process through the boundary layer formed on the steel strip surface of the treated material that mainly dominates the pickling reaction. Therefore, to promote the pickling reaction, it is necessary to accelerate the mass transfer in this process.

To encourage the reaction, the boundary layer thickness must be reduced. PTJ developed three original types of pickling tanks. The boundary layer thickness of each tank is as shown in Fig.2, and it increases in the conventional deep bath method as the strip passes through the tank, but, in the PTJ shallow bath, since there are dams and rolls in the shallow bath tank, the thickness of the boundary layer does not increase as much as in a deep bath line. In the ***i***Box® and Jet pickling designs, the thickness of the boundary layer is determined by the gap value set by the dam. It remains almost constant and does not increase.

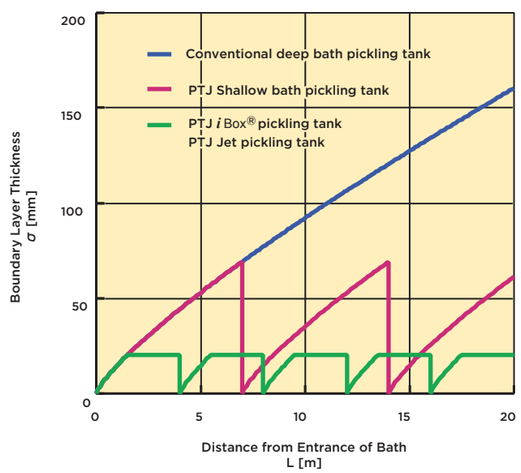
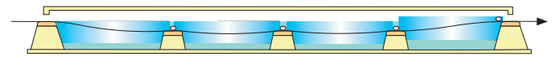


Fig. 2 Boundary layer thickness for each type of pickling tank

3. PTJ pickling technologies

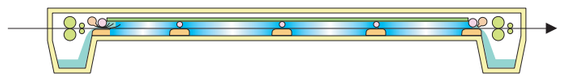
3.1 Shallow bath pickling tank

The PTJ Shallow bath pickling saves running and maintenance costs because of an in-tank heat exchanger eliminates the circulation heating system. The boundary films of the acid solution on the strip surfaces are broken by the intermediate weirs and rolls, resulting in improved pickling effect.



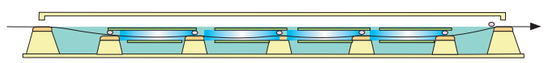
3.2 Jet pickling tank

The PTJ Jet pickling can reduce the pickling time (descaling time) by 35% to 45% compared to the conventional deep-bath type pickling tank. The acid solution is introduced into the boxed area by means of high-pressure jet nozzles. The pre-box, box and post box areas assure that the boundary layer is thinner than in a shallow bath tank.



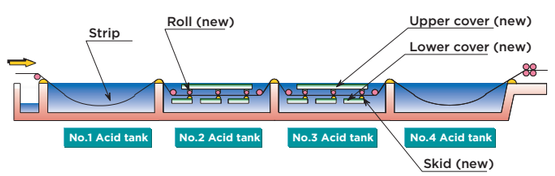
3.3 *i*Box® pickling tank

The PTJ ***i***Box® pickling is the newest and most advanced box type pickling tank. Without a circulation heating system, the pickling effect is equal to The PTJ Jet pickling tank.
Also, the ***i***Box® pickling can be installed in a conventional deep bath tank with simple modifications. Therefore, the tank is suitable for the modification of existing pickling tanks.



3.4 *i*Box® pickling tank (modification from an existing conventional deep bath tank)

The ***i***Box® pickling is suitable for modification from existing conventional deep bath tanks.
This modification can achieve the improvement of pickling speed by simple modification.



REFERENCE

UNION STEEL PL-TCM (Busan, KOREA)

For High Quality Coating Steels

Union Steel, renowned around the world as top coating steel maker, planned their first PL-TCM aiming for greater output and higher valued-added product. PTJ has supplied the most-advanced of its type.

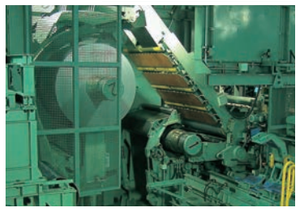
By the fusion of Union steel's passion to pursuit the most modern facility and PTJ's technology, a beautiful and smart PL-TCM was completed and started operation in April 2007.

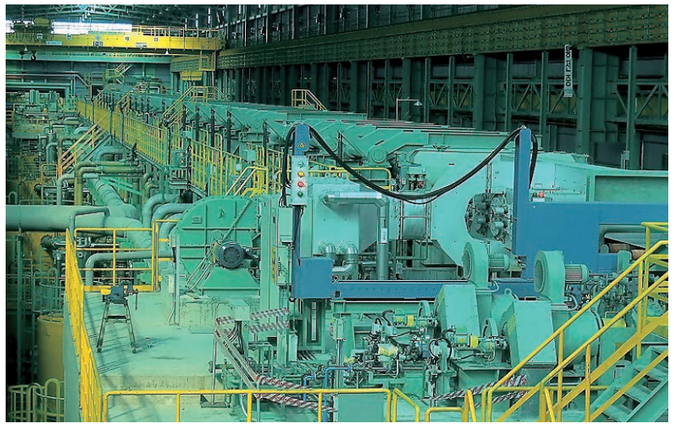
Following technologies are applied.

Full Automatic Entry and Delivery Coil Handling Systems

- Full Automatic Pickling Entry Section
- Horizontal Loop Car for Continuous high speed Pickling and Tandem Cold Rolling
- Jet Flow Pickling Technology for high speed pickling
- 5 stands 6Hi UCM-MILL for excellent gauge and shape control
- Rotary Drum Shear for High Speed Coil cutting
- Carrousel Tension Reel for continuous Coil Rewinding

Moreover, to install within the limited area, space-saving layout was sought without sacrificing operation. Compact polypropylene picking tank, well-conceived delivery equipment arrangement and underground oil and coolant room was adopted for this purpose.





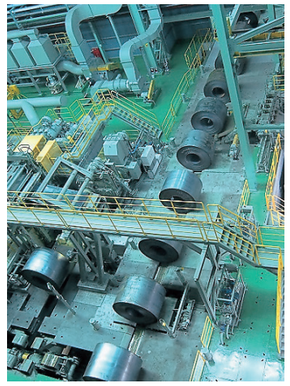
UNIQUE FEATURES

Production Data

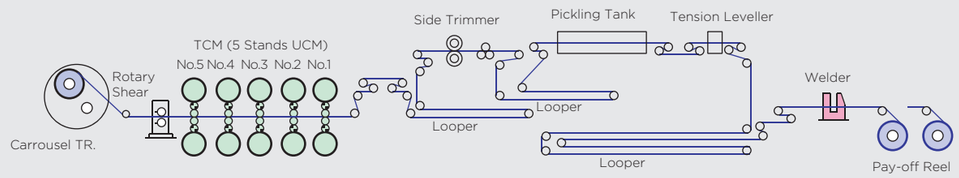
Rolled Material	: Low carbon steel
Strip Thickness :	
Entry	: 1.60 to 5.0 mm
Exit	: 0.25 to 2.3 mm
Strip Width	: 600 to 1,550 mm
Coil Diameter	: Max. 2,300 mm
Coil Weight	: Max. 35,000 kg

Line Data

Welder	: Laser Beam Welder
Pickling Tank	: JET Pickling
Side Trimmer	: Dual Turret Head type
No. of Mill Stand	: 5 stands
Type of Mill	: 6Hi UCM-MILL
Tension Reel	: Carrousel type
Inspection Station	: Off-line type
Pickling Speed	: max. 240 m/min
Rolling Speed	: max. 1,600 m/min
Dividing Speed	: max. 300 m/min



LINE CONFIGURATION

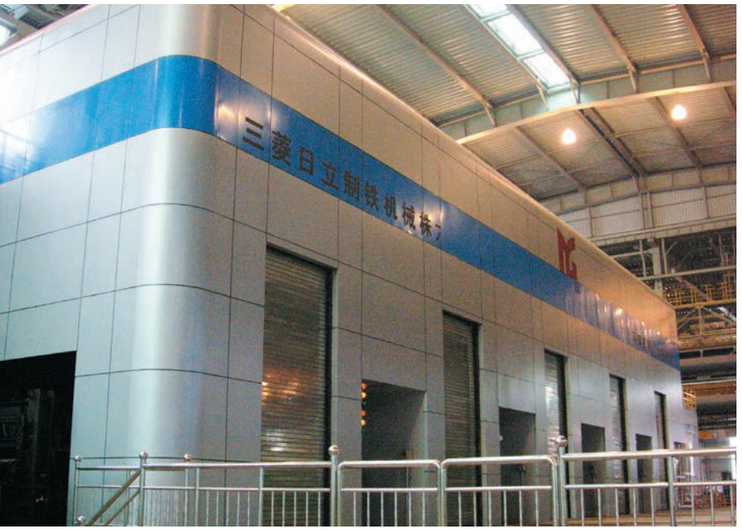


REFERENCE

MAANSHAN No.2 PL-TCM (Maanshan, CHINA)

For widest width of 2,000 mm,
Automotive - Exposed Quality Steels

Ma steel in Maanshan, the progressive steel mill in China has installed the widest Coupled Continuous Pickling and Tandem Cold Mill.
This is the No.2 PL-TCM facility and PTJ has supplied the widest and longest Jet Flow Pickling, widest 6Hi UCM-MILL Cold Rolling, High Speed dividing Carrousel Reel.
Our partner, Hitachi, Ltd., supplied the modern and sophisticated Drives, Control Systems and Automations.



LINE SPECIFICATION

Production Data

Rolled Material	: Low Carbon Steel, High Strength Steel
Strip Thickness :	
Entry	: 1.5 to 6.0 mm
Exit	: 0.25 to 2.50 mm
Strip Width	: 830 to 2,000 mm
Coil Weight	: max. 45,000 kg
Coil Diameter	: max. 2,150 mm

Line Data

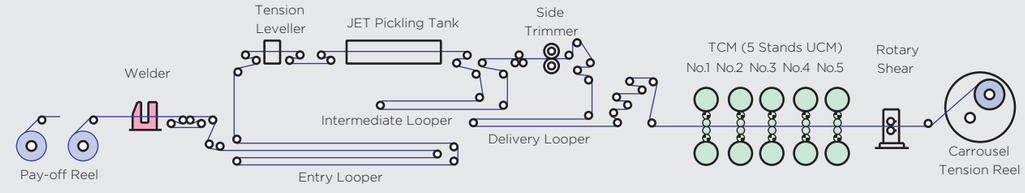
Welder	: Laser Beam Welder
Pickling Tank	: PTJ Jet Flow Pickling
Side Trimmer	: Dual Turret Head type
No. of Mill Stand	: 5 stands
Type of Mill	: 6Hi UCM-MILL
Tension Reel	: Carrousel type
Inspection Station	: Off-line type
Pickling Speed	: max. 270 m/min
Rolling Speed	: max. 1,500 m/min
Dividing Speed	: max. 250 m/min

UNIQUE FEATURES

Built for Thinner and Widest Cold Rolled Strips for Automotive-exposed Quality Applications

- Fully Automated Entry and Delivery Coil Handling Systems
- Reliable Pickling Entry Section with Fully Automatic Control Feature
- Horizontal “Push-Pull” Loop Car type Strip Accumulator for continuous high speed pickling and tandem cold rolling
- Model “JF” Jet Flow Pickling Technology for high speed pickling even with hard-to-descale materials
- High Rigidity Double Turret Head Side Trimmer with Scrap Chopper for precision side trimming Cascade-type Dual Strip Center Guides at Tandem Cold Mill Entry to ensure proper strip tracking at the mill
- 5 stands 6Hi UCM-MILL for superior strip quality and flexibility in operation
- Rotary Drum Shear for high-speed coil dividing operation
- Carrousel Tension Reel for stable and reliable coil rewinding and switchover

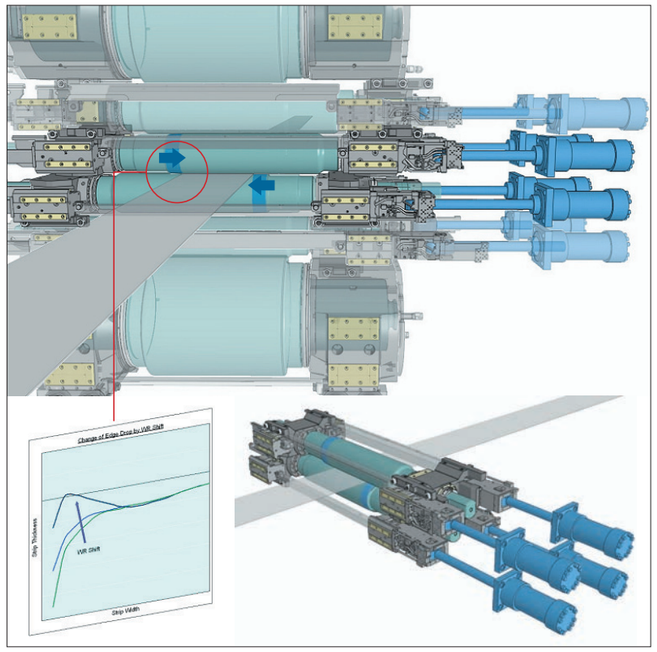
LINE CONFIGURATION



WUHAN STEEL PL-TCM (Wuhan, CHINA)

For Electrical (Silicon) Steels

Wuhan steel in Wuhan, the largest electrical (silicon) steel mill in China, has installed the first full-scale electrical steel Coupled Continuous Pickling and Tandem Cold Mill.
At the rolling of the hard material, the thickness decreases sharply at the edge area. This is called edge drop and caused by longitudinal deviation of the work roll flattening. Especially for electrical steel rolling, less edge drop is essential. To reduce the edge drop, PTJ applied UCMW-MILL, which was added work roll shift mechanism to UCM-MILL.
Work rolls are shifted by means of hydraulic cylinders provided in each shifting blocks at the drive side. Optimum roll gap profile is achieved by combining work roll shifting, intermediate roll shifting, work roll bending and intermediate roll bending.



Work Roll Shift Mechanism

LINE SPECIFICATION

Production Data

Rolled Material	: Electrical (Silicon) Steel, Low Carbon Steel
Strip Thickness :	
Entry	: 2.0 to 3.5 mm
Exit	: (Electrical)0.35 to 0.65 mm (Low Carbon) 0.30 to 1.00 mm
Strip Width	: 750～1,300 mm
Coil Weight	: max. 30,000 kg
Coil Diameter	: max. 2,100 mm

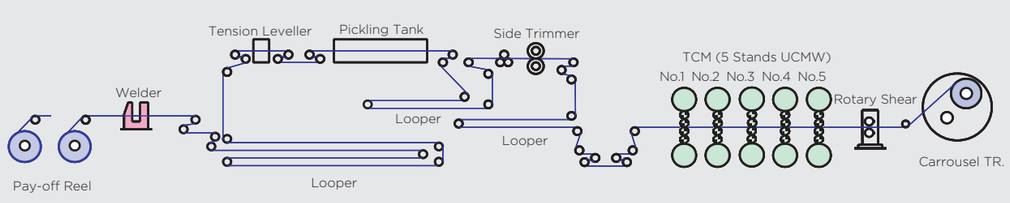
Line Data

Welder	: Laser Beam Welder
Pickling Tank	: Shallow
Side Trimmer	: Dual Turret Head type
No. of Mill stands	: 5 stands
Type of Mill	: 6Hi UCMW-MILL
Tension Reel	: Carrousel type
Inspection Station	: Off-line type
Pickling Speed	: max. 200 m/min
Rolling Speed	: max. 1,260 m/min
Dividing Speed	: max. 300 m/min

UNIQUE FEATURES

Built for Cold Rolled Strips for electrical (silicon) steel applications. Specifically, the pickling tank is a uniquely designed shallow bath tank for easier removal of silicon sludge. And, the UCMW-MILL can achieve the minimum edge drop through a work roll shifting mechanism.

LINE CONFIGURATION



REFERENCE

NISSHIN STEEL PL-TCM (Toyo, JAPAN)

With pre-reduction mill before pickling process

Nisshin Steel's Toyo Works built a modern and unique PL-TCM line.
PTJ supplied all mechanical equipment including automatic roll shop facilities.

4 stands TCM (All 6Hi UCM-MILL)

LINE SPECIFICATION

Production Data

Rolled Material	: Low Carbon Steel
Strip Thickness :	
Entry	: 1.6 to 6.6 mm
Exit	: 0.15 to 4.9 mm
Strip Width	: 580 to 1,350 mm

Line Data

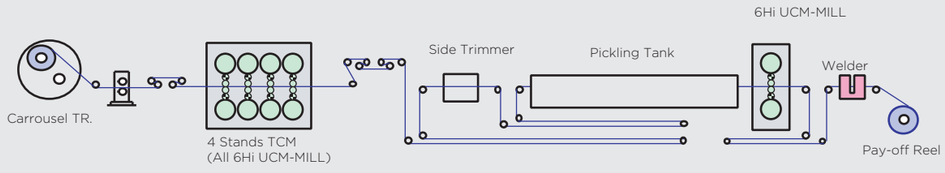
Pre-Mill	: 6Hi UCM-MILL
Welder	: Flash Welder
Pickling Tank	: Shallow Bath Pickling
Side Trimmer	: Dual Turret Head type
No. of Mill Stand	: 4 stands
Type of Mill	: 6Hi UCM-MILL
Tension Reel	: Carrousel type
Inspection Station	: Off-line type
Pickling Speed	: max. 250 m/min
Rolling Speed	: max. 1,500 m/min
Dividing Speed	: max. 300 m/min

UNIQUE FEATURES

1) Pre-reduction mill before pickling
   - Just like a strong mechanical descaller
   - Improvement of pickling effeciency
2) Improvement of productivity
   - Quick mode change from rollng to pickling
     (TCM bypass mode or TCM through mode)
3) Reduction of investment cost
   - 4 stands TCM with small work roll instead of 5 stands
4) Saving Manpower & Energy
   - Direct connection to automatic roll shop
   - 4 stands TCM with small work roll

Pre-reduction mill (6Hi UCM-MILL)
(Before Pickling process)

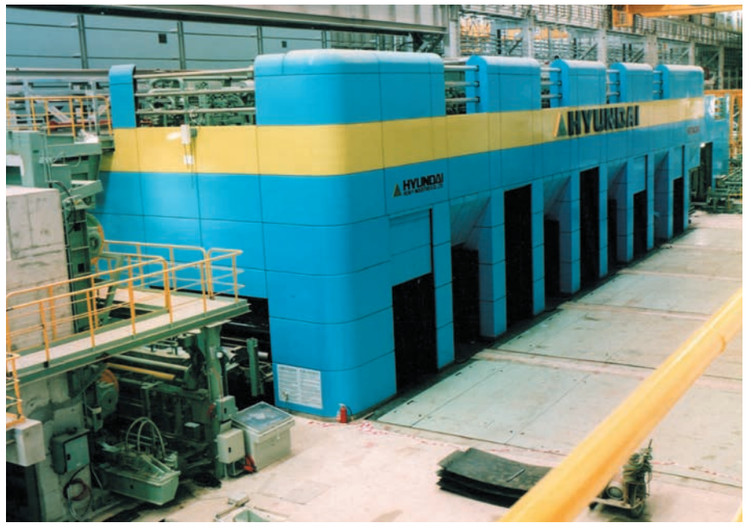
LINE CONFIGURATION



HYUNDAI PIPE PL-TCM (Suncheon, KOREA)

Applying UCMW technology to automobile facility

HYUNDAI HYSCO is the biggest steel supplier to HYUDAI Motor.
HYUDAI Motor is the biggest automobile company in korea.
PTJ supplied TCM mechanical equipment including roll shop facilities.



5 Stands TCM (All 6Hi-UCMW-MILL)

LINE SPECIFICATION

Production Data

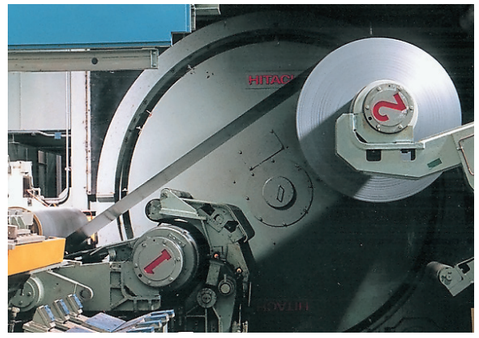
Rolled Material	: Low Carbon Steel
Strip Thickness :	
Entry	: 1.6 to 5.0 mm
Exit	: 0.23 to 2.3 mm
Strip Width	: 700 to 1850 mm
Coil Weight	: max. 38,000 kg

Line Data

No. of Mill Stand	: 5 stands
Type of Mill	: 6Hi UCMW-MILL With Work Roll Shift
Tension Reel	: Carrousel type
Inspection Station	: Off-line type
Pickling Speed	: max. 200 m/min
Rolling Speed	: max. 1,500 m/min
Dividing Speed	: max. 250 m/min

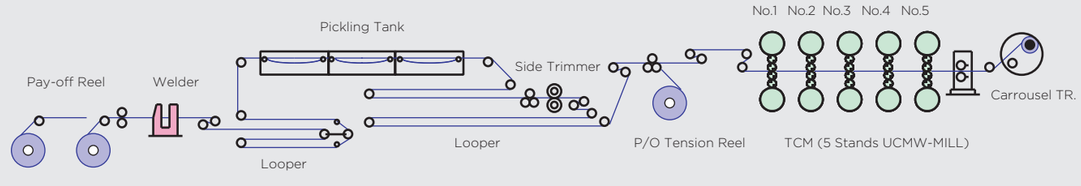
UNIQUE FEATURES

1) PTJ 6Hi UCMW-MILL
   - Stable rolling
   - Reducing strip edge drop (high yield rate)
2) High productivity
   - Annual productivity: 1,670 kton/year
     (Recent HYUNDAI actual: Over 1,950 kton/year)
3) Pickled Out Tension Reel
   - High-efficiency P/O coil production
4) Saving Manpower & Energy
   - Full automatic roll changing operation
   - Automatic coil handling at TCM exit



Carrouel Tension Reel

LINE CONFIGURATION



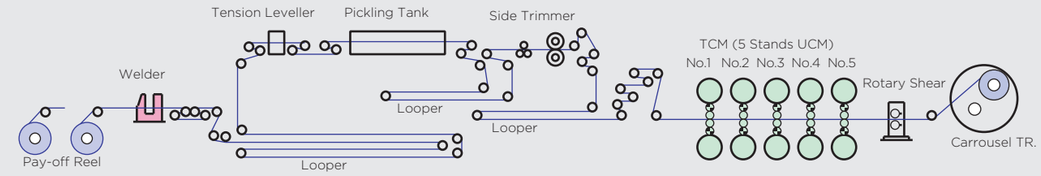
REFERENCE

BENXI STEEL No.2 PL-TCM (Benxi, CHINA)

MAIN SPECIFICATION

No.	Item	Description
1.	Material	Material : Low Carbon Steel, High Strength Steel Thickness : Entry 1.8 to 6.0 mm : Delivery 0.2 to 2.5 mm (For Automobile and construction) Width : 800 to 1,870 mm Coil weight : Max. 31,500 kg (48,000 kg)
2.	Speed	Pickling speed : Max. 250 m/min Rolling speed : Max. 1,650 m/min Strip dividing speed : Max. 250 m/min
3.	Weld Type	Laser Beam Welder
4.	Pickling Type	Jet Bath
5.	Mill Type	No.1 : 6Hi MILL (UCM) No.2 : 6Hi MILL (UCM) No.3 : 6Hi MILL (UCM) No.4 : 6Hi MILL (UCM) No.5 : 6Hi MILL (UCM)

LINE CONFIGURATION

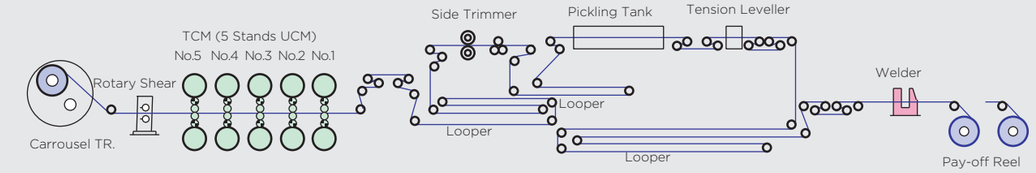


SHOUGANG JINGTANG PL-TCM (Caofeiden, CHINA)

MAIN SPECIFICATION

No.	Item	Description
1.	Material	Material : Hot Rolled Carbon Steel Thickness : Entry 1.6 to 5.0 mm : Delivery 0.25 to 2.5 mm (For Contruction,Automotive) Width : 750 to 1,580 mm Coil weight : Max. 35,000 kg
2.	Speed	Pickling speed : Max. 220 m/min Rolling speed : Max.1,400 m/min Strip dividing speed : Max. 260 m/min
3.	Weld Type	Laser Beam Welder
4.	Pickling Type	Jet Bath
5.	Mill Type	No.1 : 6Hi MILL (UCM) No.2 : 6Hi MILL (UCM) No.3 : 6Hi MILL (UCM) No.4 : 6Hi MILL (UCM) No.5 : 6Hi MILL (UCM)

LINE CONFIGURATION

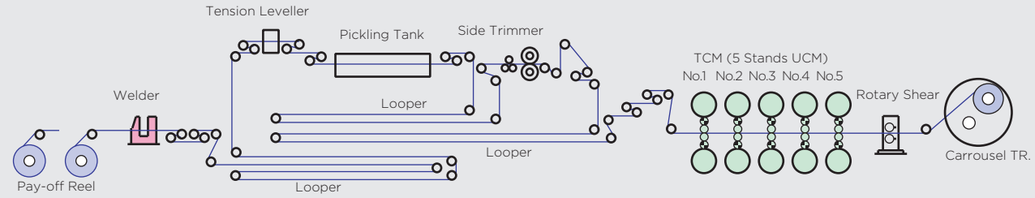


JIQUAN STEEL PL-TCM (Jinguan, CHINA)

MAIN SPECIFICATION

No.	Item	Description
1.	Material	Material : Hot Rolled Carbon Steel Thickness : Entry 1.8 to 6.0 mm : Delivery 0.25 to 3.0 mm (For Construction) Width : 830 to 1,660 mm Coil weight : Max. 31,000 kg
2.	Speed	Pickling speed : Max. 200 m/min Rolling speed : Max.1,200 m/min Strip dividing speed : Max. 260 m/min
3.	Weld Type	Shear built-in Laser Welder
4.	Pickling Type	Jet Bath
5.	Mill Type	No.1 : 6Hi MILL (UCM) No.2 : 6Hi MILL (UCM) No.3 : 6Hi MILL (UCM) No.4 : 6Hi MILL (UCM) No.5 : 6Hi MILL (UCM)

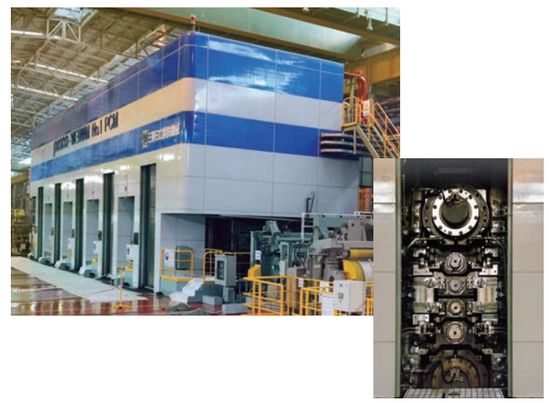
LINE CONFIGURATION



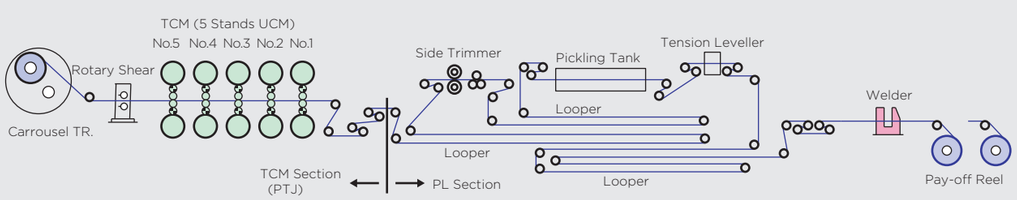
POSCO-VIETNAM PL-TCM (Phu My, VIETNAM)

MAIN SPECIFICATION

No.	Item	Description
1.	Material	Material : Low Carbon Steel, High Strength Steel Thickness : Entry 1.8 to 5.0 mm : Delivery 0.15 to 1.6 mm (For Construction) Width : 700 to 1,570 mm Coil weight : Max. 35,000 kg
2.	Speed	Rolling speed : Max. 1,700 m/min Strip dividing speed : Max. 250 m/min
3.	Mill Type	No.1 : 6Hi MILL (UCM) No.2 : 6Hi MILL (UCM) No.3 : 6Hi MILL (UCM) No.4 : 6Hi MILL (UCM) No.5 : 6Hi MILL (UCM)



LINE CONFIGURATION



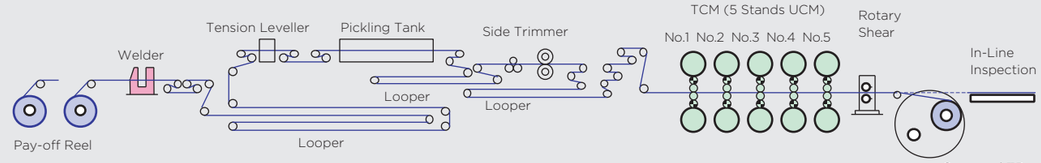
REFERENCE

SEVERSTAL DEARBORN PL-TCM (Dearborn, USA)

MAIN SPECIFICATION

No.	Item	Description
1.	Material	Material : Low Carbon Steel, High Strength Steel Thickness : Entry to 6.35 mm : Delivery 0.37 (0.30) to 2.67 mm (For Automobile) Width : 736 to 1,829 mm Coil weight : Max. 32,700kg
2.	Speed	Pickling speed : Max. 290 m/min Rolling speed : Max. 1,100 m/min Strip dividing speed : Max. 250 m/min
3.	Weld Type	Laser Beam Welder
4.	Pickling Type	iBox Type
5.	Mill Type	No.1 : 6Hi MILL (UCM) No.2 : 6Hi MILL (UCM) No.3 : 6Hi MILL (UCM) No.4 : 6Hi MILL (UCM) No.5 : 6Hi MILL (UCM)

LINE CONFIGURATION

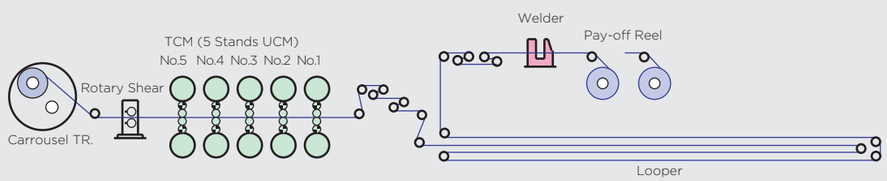


BAOSHAN STAINLESS STEEL (Shanghai, CHINA)

MAIN SPECIFICATION

No.	Item	Description
1.	Material	Material : Hot Rolled (Pickled) Stainless Steel : Hot Rolled (Pickled) Carbon Steel Thickness : Entry 2.0 to 6.0 mm : Delivery 0.3 to 2.3 mm (For Contruction) Width : 730 to 1,630 mm Coil weight : Max. 30,000 kg
2.	Speed	Entry speed : Max. 650 m/min Rolling speed : Max.1,300 m/min Strip dividing speed : Max. 300 m/min
3.	Weld Type	Shear built-in Laser Welder
4.	Mill Type	No.1 : 6Hi MILL (UCM) No.2 : 6Hi MILL (UCM) No.3 : 6Hi MILL (UCM) No.4 : 6Hi MILL (UCM) No.5 : 6Hi MILL (UCM)

LINE CONFIGURATION

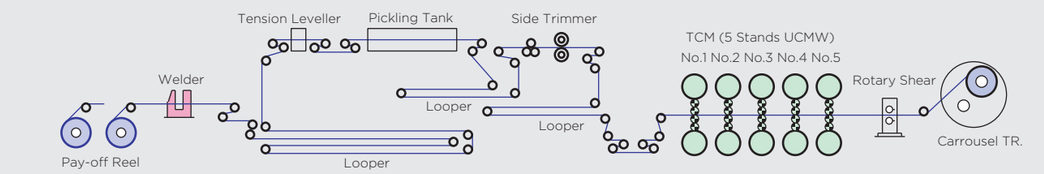


SHOUGANG CORPORATION PL-TCM (Qian'an, CHINA)

MAIN SPECIFICATION

No.	Item	Description
1.	Material	Material : Special Steel Thickness : Entry 2.0 to 3.0 mm : Delivery 0.35 to 0.65 mm Width : 750 to 1,300 mm Coil weight : Max. 30,000 kg
2.	Speed	Pickling speed : Max. 200 m/min Rolling speed : Max. 1,200 m/min Strip dividing speed : Max. 300 m/min
3.	Weld Type	Shear built-in Laser Welder
4.	Pickling Type	Shallow
5.	Mill Type	No.1 : 6Hi MILL (UCMW) No.2 : 6Hi MILL (UCMW) No.3 : 6Hi MILL (UCMW) No.4 : 6Hi MILL (UCMW) No.5 : 6Hi MILL (UCMW)

LINE CONFIGURATION

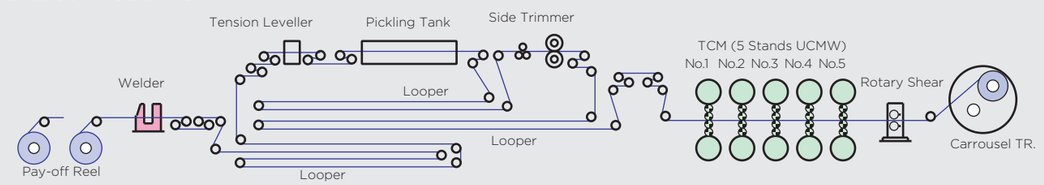


CHINA STEEL CORPORATION No.3 PLCM (Kao-hsiung, TAIWAN)

MAIN SPECIFICATION

No.	Item	Description
1.	Material	Material : Pickled Carbon Steel, High strength steel, Electrical Steel Thickness : Entry 1.5 to 6.6 mm : Delivery 0.3 to 3.2 mm (For Automotive, Construction) Width : 914 to 1,880 mm Coil weight : Max. 35,500 kg
2.	Speed	Pickling speed : Max. 250 m/min Rolling speed : Max. 1,400 m/min Strip dividing speed : Max. 250 m/min
3.	Weld Type	Shear built-in Laser Welder
4.	Pickling Type	Jet Bath
5.	Mill Type	No.1 : 6Hi MILL (UCMW) No.2 : 6Hi MILL (UCMW) No.3 : 6Hi MILL (UCMW) No.4 : 6Hi MILL (UCMW) No.5 : 6Hi MILL (UCMW)

LINE CONFIGURATION



REFERENCE

POSCO (Gwang Yang, KOREA)

Minimum Outage and Vertical Start up at Revamping Project.

At POSCO K1CX project, POSCO and PTJ successfully completed the revamping of the tandem cold mill. The revamping required the scrupulous planning and large stock of experiences. PTJ's total engineering ability was exemplified even at the intricacy revamping project.
PTJ propose the best revamping plan to reinforce the existing facilities, to increase the output, to minimize the outage period and commissioning period, and to start up vertically, which is based on the reliable technologies.

Installation of No.0 stand (UCMW)

MAIN SPECIFICATION

No.	Description		Before Revamping	After Revamping
1.	Material		Low Carbon Steel	Low Carbon Steel
			Low Alloy Steel	Low Alloy Steel
			-	High Strength Steel
2.	Raw Material	Thickness mm	1.4 to 6.0	1.4 to 6.0
		Width mm	760 to 1,880	760 to 1,880
3.	Prouction	Thickness mm	0.2 to 3.0	0.2 to 3.0
		Width mm	720 to 1,860	720 to 1,860
		TCM Entry mpm	300	350
		TCM Exit mpm	1,200	1,600
4.	Mill Entry Bridle	Exit Tension Ton	35	45
5.	TCM	No.of Stand	4	5
		Mill Type #0	-	UCMW
		Mill Type #1,2	HCMW	HCMW
		Mill Type #3,4	UCMW	UCMW
		Main Drive	DC Twin Drive	AC Single Drive
		Rolling Force ton	2,500	2,700

UNIQUE FEATURES

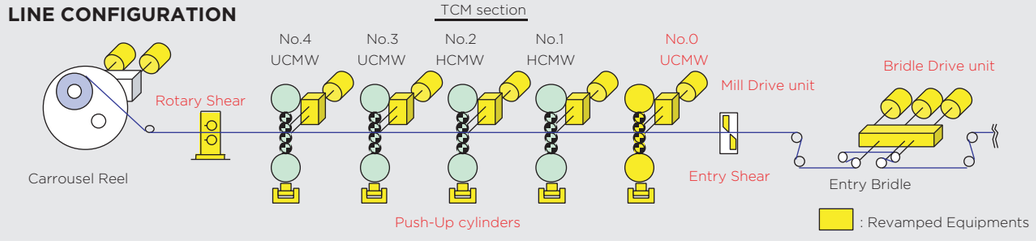
For improvement quality of product:
- Added No.0 stand (UCMW)〜 Shape stability and wide range shape controllability
- DC drive → High response AC drive
- Applied advanced vertical type inspection station

For improvement of productivity:
- Added No.0 stand (UCMW) 〜 Stable rolling at heavy reduction for HSS rolling
- Incresed output of push-up cylinder (HYROP-F) for HSS rolling

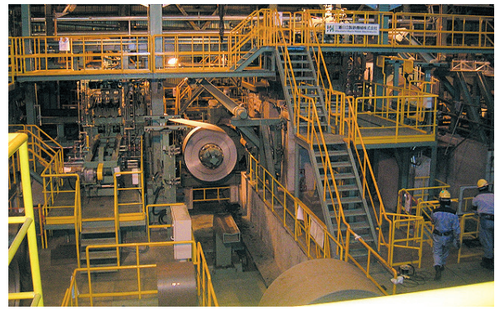
For increasing production:
- Increased rolling speed to 1,600 m/min with cylindrical roller bearing for BUR

Advanced inspection station for high quality automotive steel

LINE CONFIGURATION



JFE STEEL KEIHIN 5 STANDS TCM (Kawasaki, JAPAN)



UNIQUE FEATURES

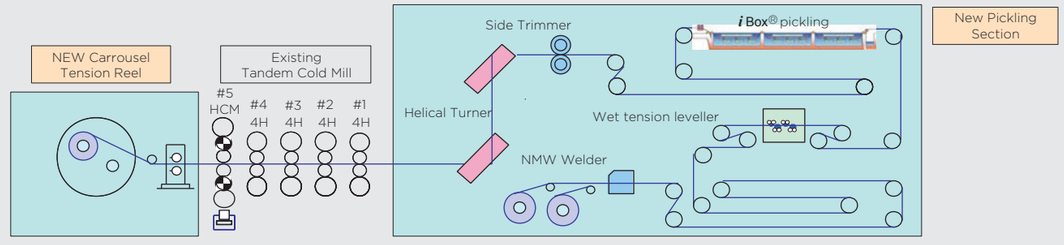
Batch type tandem cold mill was refreshed to the continuous PL-TCM with *i* Box® pickling

The old fashioned batch type tandem cold mill was coupled with up-to date pickling line and carrousel tension reel. Even the mill entry area did not have enough space, the mill can be upgraded to the PL-TCM with applying the various technologies, and completed the shut down work with minimum outage.

MAIN SPECIFICATION

No.	Description		Before Revamping	After Revamping
1.	Material		Low Carbon Steel	Low Carbon Steel
2.	Raw Material	Thickness mm	1.6 to 4.5	1.6 to 4.5
		Width mm	600 to 1,350	600 to 1,350
3.	Prouction	Thickness mm	0.25 to 1.6	0.25 to 1.6
		Width mm	600 to 1,350	600 to 1,350
		PL Section mpm	-	250
		TCM Entry mpm	-	350
		TCM Exit mpm	2,100	2,100
4.	Pickling	PL Type	-	*i* BOX®
5.	TCM	No.of Stand	5	5
		Mill Type #1-4	4H	4H
		Mill Type #5	HCM	HCM
6.	Tension Reel		One Tension Reel	Carrousel Tension Reel

LINE CONFIGURATION



SUMITOMO METAL 2TCM (Kashima, JAPAN)

UNIQUE FEATURES

To improve the productivety, the continuous tandem cold mill was upgraded to PL-TCM with *i* Box® pickling for automobile steel.

The new pickling line was coupled to the exisiting tandem cold mill, which product high quality automobile steel.
The *i* Box® pickling, which was high performance, energy saving and unique designed, was appilied.

AWC trimmer (automatically width change without line stopping) was adopted to keep the stable operation, and newly designed automatic baller was installed for thicker gauge trimmed scrap.

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