CONTROLLED ELONGATION MACHINES FOR PROCESSING LINES
GREATER PERFORMANCE, INNOVATIVE PROCESSES AND HIGHER QUALITY
COMMITTED TO CONTINUOUS IMPROVEMENT

YOUR CHALLENGE
Flat-rolled steel producers are facing a trend towards zero-defect tolerances regarding surface and shape quality. This trend is now becoming the standard in the whole steel industry: automotive, packaging, appliance, building, etc.

Such performance requires a perfect knowledge and control of the production. Yet, the development of new steel grades (e.g., ultra high strength steels) have introduced a lot of changes in the way steel is made, making this more difficult to achieve.

In addition, the push towards high throughput rates and yield requires fully automatic equipment running without operator assistance.

OUR SOLUTION
Primetals Technologies has been a leader in the iron and steel business for Controlled Elongation Machines (CEM) since 1953. Building on our expertise, we have created an ongoing global evolution program for all CEM types. Our CEMs continue to achieve all crucial success metrics and are supported by numerous patents that result in higher performance, increased reliability and better adaptability to innovations in steel (high-strength steel, etc.).

The first step of our program included the redesign of our existing skin-pass mills and tension levelers, with a focus on three models - light, medium and heavy. Over the past decade, this has generated more than 100 satisfied customers in all parts of the world.

The second step involved the creation of a new generation of multi-roll tension levelers for tinplate production, with a focus on three models - light, medium and heavy. Over the past decade, this has generated more than 100 satisfied customers in all parts of the world.

GOOD REASONS FOR CONTROLLED ELONGATION MACHINES

• User-friendly operation
  All of our CEMs have been designed for easy use. An up-to-date HMI (human-machine interface) ensures efficient troubleshooting and facilitates easy operation control. Readily accessible components (cylinders, rolls, etc.) make maintenance and replacing parts easy and efficient.

• Mechatronic package for optimized functionality
  The mechatronic package is a combination of technological and electrical automation know-how for optimized functionality.

• Complete workshop testing
  Our CEMs are assembled and tested in our workshop in Montbrison, France. Testing includes mechanical adjustments, hydraulic pressure tests and automation. Every CEM is fine-tuned to make its integration into your facility as smooth as possible. Since 1994, Primetals Technologies workshop in Montbrison, France, has complied with the international quality standards (ISO 9002 then, ISO 9001 today).

• Perfect integration
  Our CEMs have been designed for a perfect integration into processing lines. The easy customizing through peripheral equipment and clear interfaces allows the installation in existing lines or own line design.
ADVANTAGES OF STRIP PROCESSING UNDER CONTROLLED ELONGATION

PrimeTechs Technologies has chosen the controlled elongation method because of the numerous advantages to be gained: direct elongation control permits the processing of metal strip with yield and tensile strengths close to each other, without the risk of strip break during processing.

Elongation remains constant for a given operation and is not influenced by any of the following factors:
- Variations in strip gauge
- Variations in strip width
- Mechanical and/or metallurgical properties of strip
- Variations in strip velocity
- Variation of the friction coefficient

It follows that during skin passing, whether or not in combination with tension leveling, the ratio of rolling tension can easily be modified while maintaining elongation to the target value and, therefore, obtain the desired quality.
SKIN-PASS MILL

With Primetals Technologies, you benefit from the experience of a world leader in these technologies. Our solution range encompasses skin-pass mills that cover all applications. With rolling force capacities ranging from 500 to 1,300 tons, skin-pass mill stands can be of two-high or four-high design, thus providing a best-in-class solution, whatever your application.

TENSION LEVELER

The purpose of the tension leveling stand is to improve product flatness by stretching all of the longitudinal structures in the metal strip to equal length. The operation consists of submitting the strip to an elasto-plastic deformation with controlled elongation, with several six-high leveling cluster assemblies. An anti-crossbow roll, located downstream of the leveling rolls, eliminates the crossbow and coilset induced by a strip passing over a small diameter roll.

SCALE BREAKER

This is a time-tested technology from Primetals Technologies. The scale breaker is comprised of a stand (including two sets of two leveling units and an anti-crossbow unit), a dust collection system (wet or dry process), as well as entry and exit tension bridles with their respective drive systems. More than 50 of these timetested machines are operating worldwide.

MULTI-ROLL TENSION LEVELER

Due to increasing demand, tinplate producers are now supplying thinner average product gauges and double reduced (DR) materials that are difficult to level because of their light gauge, high yield strength and internal stress. To respond to these more stringent market requirements, a few years ago Primetals Technologies developed a new type of tension leveler specifically designed for high quality production in electrolytic tinning lines and tinplate inspection and leveling lines.
With more than 450 references worldwide, Primetals Technologies is undeniably the world leader in these technologies.

In most cases the equipment comprises four-high mills with one or two work roll diameters. The equipment integrates positive and negative bending blocks, an automatic pass-line adjustment device, a quick automatic work roll change system, efficient roll cleaning tools, high-performance automation and a wet rolling unit, when required.

Primetals Technologies offers an extensive range of skin-pass mills to cover all applications. With rolling force capacities ranging from 500 to 1,300 tons, skin-pass mill stands can be of two-high or four-high design, depending on the application.

As a mechatronic package, Primetals Technologies supplies the total automation system from the actuators up to the preset generation as well as supervision.

The main functions are:

**LEVEL 1:**
- Sequential control for auxiliaries
- Drives control
- Hydraulic screw-down control loops
- Speed and tension controls
- Flatness measurement and regulation using multivariable theories
- Elongation control by force and/or tensions
- Mill master which generates references for speeds and tensions

**LEVEL 2:**
- Preset generation based on mathematical models and/or neuronal models
- Networks with self adaptation
- Data logging and production reporting

**Application**  PPPL, CPL, CAL, CGL, APL, TM-TL lines

**Function**  Surface/roughness finishing and yield point removal

<table>
<thead>
<tr>
<th>Product thickness</th>
<th>0.20 to 6.50 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product width</td>
<td>500 to 2,100 mm</td>
</tr>
<tr>
<td>Product yield strength</td>
<td>Up to 1,250 Mpa</td>
</tr>
<tr>
<td>Line speed</td>
<td>Up to 600 mpm</td>
</tr>
</tbody>
</table>

Primetals Technologies is the world leader in these technologies with 35 tension levelers in the past five years. Tension leveling stands include several six-high leveling cluster assemblies on which the strip is subjected to elasto-plastic deformation under controlled elongation in order to stretch the strip’s longitudinal structures to equal length and to eliminate residual crossbow and coilset.

Tension leveler entry and exit tension bridles can be driven with different systems (interconnecting gear boxes or all electrical drives) depending on the application. It is often desirable to combine the skin-pass and tension leveler with an intermediate tension bridle in a versatile system. This facilitates the production of different types of high-quality strip.
A time-tested technology from Primetals Technologies that has resulted in orders for more than 50 machines delivered worldwide since 1978. The scale breaker is composed of a stand (including two sets of two leveling units and an anti-crossbow unit), a dust collection system (wet or dry process), as well as entry and exit tension bridles with their respective drive systems. The strip in the stand is subjected to a series of alternating flexions under tension on the work rolls. This results in an elongation of the strip and corrects flatness defects. The oxide layer is cracked and partially removed from the strip, thus increasing the efficiency of the acid pickling process. The machine operates automatically in controlled elongation mode using a preset database system.

The scale breaker is also equipped with a quick work roll changing device which operates when the line is running, as well as a complete hooding of the stand to prevent pollution to the surroundings, and back-up rolls with built-in air blowing systems to prevent dust penetration.

The achieved strip flatness (correction of wavy edges, buckles, camber and crossbow) is sensational, with results of less than 5 I-units on processed strips. The improvement in pickling efficiency can lead to a capacity increase of 30%.

Primetals Technologies has patented the design of a number of tension levelers and has supplied more than 50 tinplate units worldwide since 1969, including 15 of the multi-roll type in the last 15 years. The most recent generation is a compact and highly rigid machine with integrated tension bridles that operate automatically in a controlled elongation running mode based on a preset database system. Entry and exit tension bridles are interconnected and driven by a gearbox drive with differential. The drive enables a very slight and accurate reduction of the entry bridle speed in order to set the elongation. The leveling stand includes flexible tension leveling units and a multi-roll unit.

Nearly the entire elasto-plastic deformation of the strip is carried out in the flexible tension units. The aim of the multi-roll unit is to reduce coilset and finally to ensure that the internal residual stresses are balanced throughout the cross-section of the material. Since most tinplate tension levelers are able to address severe wavy edges, other shape characteristics such as crossbow, coilset and bow blanks remain critical for light-gauge hard products such as DR materials. These requirements are now met by the integrated multi-roll tension leveler from Primetals Technologies. The industrial results achieved on DR material show that 100% of the products have a linebow within minus 25 mm and plus 20 mm, with a crossbow of less than 20 mm. For the differential bow blanks, 100% of the products display a differential bow blank of less than 13 mm. 100% of the wavy-edge products display a slope of less than 1%.

### Application
- Carbon steel: PPPL, CPL
- Stainless steel: CAL, APL

### Function
- Flatness improvement
- Increase in descaling and pickling

### Product characteristics
- **Product thickness**: 0.6 to 8.0 mm
- **Product width**: 500 to 2,100 mm
- **Product yield strength**: Up to 600 Mpa
- **Line speed**: Up to 500 mpm

### Application
- ETL, ECCL, TL lines, recolling lines

### Function
- Internal stress removal

### Product characteristics
- **Product thickness**: 0.1 to 0.8 mm
- **Product width**: 500 to 1,400 mm
- **Product yield strength**: Up to 1,200 Mpa
- **Line speed**: Up to 700 mpm
CONTROLLED ELONGATION TEST FACILITY

Primetals Technologies has designed a full-scale controlled elongation testing facility with enough versatility to be able to process a wide range of materials. It is used for conducting research and development work as well as testing customers’ samples. It is designed to operate under conditions similar to those found in all applications that use controlled elongation technology. Machine components, such as flexing units, type and number of tension bridle rolls and interconnecting drive trains, can be adapted to simulate various strip finishing operations.

The test facility also features a cold-rolling or temper mill stand which can be configured as a two-high, with 300 mm diameter rolls, and as a four-high, with 140 mm diameter work rolls. Maximum rolling force is 1,200 kN with a maximum tension exerted on the strip of approximately 60 kN that is monitored by tensiometers.

LIFE-CYCLE MANAGEMENT
PARTNERSHIP NEVER ENDS

As a plant operator, you have conflicting needs. On the one hand, your performance is measured each quarter against short-term profitability expectations. On the other hand, you have to think on a totally different timescale compared with the capital market. Depending on the lifetime of your plant, you have to take 15 years or more into account. At the very least, that is 60 full quarters.

But thanks to our comprehensive expertise and integrated approach to solutions, you benefit both short-term and long-term from our life-cycle services.

In the short-term: Backed by our extensive experience with many reference plants, we provide you with the certainty of fast, dependable production start-up and shorter amortization periods.

In the long term: Our master plan guarantees competitive performance for your plant in every phase of its life cycle. Whether we’re providing 24/7 technical support, optimizing maintenance, or making permanent plant improvements, we are always working to ensure the cost-effective operation of your plant.
SKIN-PASS MILL
Customer. ArcelorMittal, Mardyck, France
Plant type. SPM H in continuous galvanizing line
Our solution. 1,200 ton skin-pass mill mechatronic package
The result. Good results in roughness transfer on strip for automotive
Technical data. Width: 900-1,680 mm; thickness: 0.50-2.00 mm
Other references. Tata Steel, Posco, Baosteel

TENSION LEVELLER
Customer. Pangang, China
Plant type. TL in a continuous galvanizing line
Our solution. 25 ton tension leveler
The result. Good flatness with wide products
Technical data. Max. Width: 1,650 mm; thickness: 0.50-3.00 mm
Other references. Masteel, ArcelorMittal, Tata Steel, Posco

SCALE BREAKER
Customer. Tangshan, China
Plant type. SB M in a PLTCM
Our solution. 65 ton scale breaker
The result. Good flatness and scale removal on hard product
Technical data. Max. width: 1,620 mm; thickness: 1.50-6.0 mm
Other references. Posco, ArcelorMittal, USS, Posco

MULTIROLL TENSION LEVELLER
Customer. Rasselstein, Andernach, Germany
Plant type. MTL H continuous annealing line
Our solution. 8.5 ton multiroll tension leveler mechatronic package
The result. Internal stress removal on DR product
Technical data. Width: 900-1,400 mm; thickness: 0.10-0.70 mm
Other references. ArcelorMittal, Tata Steel, Posco

EXCELLENCE FROM EXPERIENCE
Selected success stories with controlled elongation machines for processing lines
The information (including, e.g., figures and numbers) provided in this document contains merely general descriptions or characteristics of performance based on estimates and assumptions which have not been verified. It is no representation, does not constitute and/or evidence a contract or an offer to enter into a contract to any extent and is not binding upon the parties. Any obligation to provide and/or demonstrate respective characteristics shall only exist if expressly agreed in the terms of the contract. These estimates and assumptions have to be analyzed on a case-to-case basis and might change as a result of further product development. Primetals Technologies excludes any liability whatsoever under or in connection with any provided information, estimates and assumptions. The provided information, estimates and assumptions shall be without prejudice to any possible future offer and/or contract.

Any use of information provided by Primetals Technologies to the recipient shall be subject to applicable confidentiality obligations and for the own convenience of and of the sole risk of the recipient.