



Measurement & Analytics | Measurement made easy

# Stressometer<sup>®</sup> Systems 9.0 FSA

## Flatness measurement and control

# Stressometer® Systems

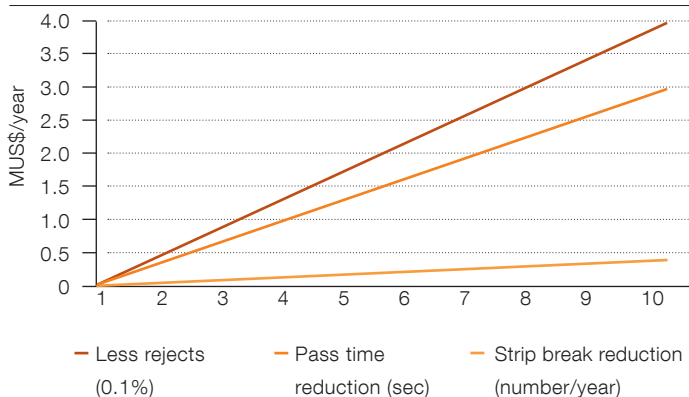
## Make the difference

High performing flatness measurement and control is a critical success factor for flat rolling mills. It is the difference between winning and losing market share. A well functioning system will have great impact on the bottom line result. The Stressometer System 9.0 FSA is designed to combine the best strip flatness performance with the lowest cost of ownership.

### Unique technology

Our technology includes a calibration-free system with an unsurpassed measurement density and response time, long-term accuracy and integrated model based multivariable control. These features will boost mill productivity and yield while increasing quality and value of the rolled strip.

### Small improvements have great impact



Sensitivities to Bottom Line regarding three different productivity aspects for a typical 5 stand Tandem Cold Mill.

ABB can help you evaluate your particular mill.

### Minimize rejects

Direct and Parallel Measurement means accurate measurements, unaffected by strip tension variations, within milliseconds of rolling. This enables full flatness control including strip head and tail ends thereby reducing rejects. The improved flatness will also lead to reduced downstream defects.

### Minimize pass time

With Stressometer in the mill, strip break risks due to bad flatness will not limit acceleration and mill speed. Pass times are reduced and productivity increased. The improved strip edge control is enabled thanks to edge measurement resolution down to a few millimeters.

### Minimize production disturbances

Partly covered measurement zones at the strip edges are fully utilized to rapidly correct high edge stresses thereby avoiding strip breaks. To further increase strip edge control, narrow measurement zones and/or Millmate Strip Scanner for edge detection can be used.





"The payback time ending up with less than a year."  
ILNOR, Venice, Italy

#### Minimize cost of ownership

- Outstanding system reliability. Based on the performance of more than 1500 roll installations mean time between failures (MTBF) has proven to exceed 20 years
- On-site recalibration of the roll is not necessary; sensor sensitivity will not change over time
- Future safe system. The FSA platform follows mainstream non-proprietary technologies in both HW and SW thereby ensuring future development and software reuse
- Low power and air consumption

#### Minimize environmental impact

- Substantial scrap reduction results in considerable decrease of carbon footprint
- Improved flatness from the cold mill reduces downstream rejects and environmental impact

Increase productivity, save energy and reduce environmental impact. ABB provide total flatness control with Direct and Parallel Measurement in a future-safe system.

# Stressometer® Flatness Control

## Total control is the difference

The Stressometer Flatness Control System will minimize rejects, pass times and strip breaks. This is achieved thru the use of all mill actuators, both mechanical and thermal, in an optimal way for creating the best possible flatness.

### Mechanical control

The system will simultaneously control all available mechanical actuators in the mill. All actuators have accurate models, defining the flatness action, stored in the system. These models are used for optimally extracting actuator components from the flatness error.

Some features of the mechanical flatness control:

- Predictive control
- Accurate actuator models and tuning capabilities
- Change of control strategies on-line
- Flatness Control with Extended Singular Value Decomposition (ESVD)
- Identification of process model

### Predictive control

Great yield improvements and drastic rejects reduction can be achieved by using the system's predictive controller. Important when using a predictive controller is to have an accurate process model. This is ensured by built-in automatic process identification tools.

More than 50 % reduction of downstream rejects have been achieved after installation of the predictive controller. Dead time compensation is used to speed up the control at low speed and during acceleration/deceleration. The result is a much more competitive rolling mill.

### Accurate actuator models and tuning capabilities

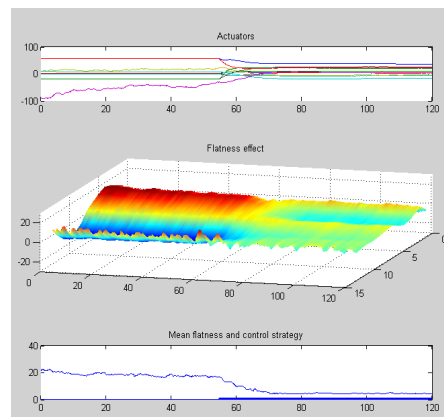
The models are easily tuned during commissioning and adapted on-line to the actual rolling condition. Process parameters such as gain, delay time and actuator time constants are automatically identified with just one click.

### Change of control strategies on-line

A set of control strategies is customized for each individual mill. The system will automatically select and activate the desired strategy for each control situation.

### Flatness Control with Extended Singular Value Decomposition (ESVD)

A problem in many Cluster Mills is that several different actuator combinations will cause the same flatness change. To find the optimal actuator combination in any given situation has until recently been impossible. ABB's patented method will however find these actuator combinations while considering all constraints e.g. actuator speed and available range. Minimal wear on actuators and bearings are achieved thru the optimal actuator pattern. Traditional control systems are extremely sensitive to model errors and flatness errors even if these are very small. The ESVD method ensure a robust, fully automatic control even in mills with a large number of actuators.



Switching from traditional control to ESVD control minimizes actuator displacements which will move actuators from limit situations and drastically improves flatness.



## Identification of process model

### Tuning tool

- Reliable model identification during rolling with negligible flatness disturbance
- Identification done within seconds
- Graphical feedback shows the accuracy of the model
- Easy to repeat the identification for other strips with other properties
- Easy to detect if the actuators have the same behavior over time

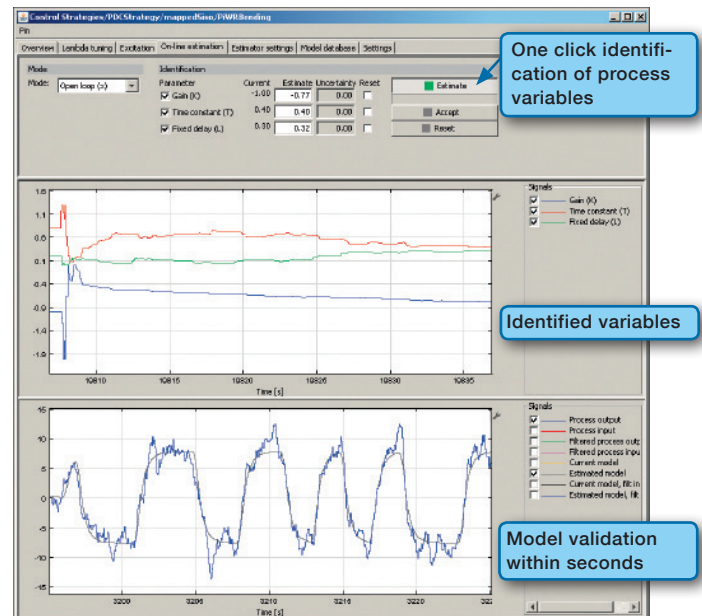
### Benefits

- No loss of flatness quality during model identification
- Shorter tuning time
- **Maximum flatness quality through accurate process models**

## Thermal control

In four and six high mills thermal control of the roll gap is used to remove non-symmetrical flatness errors and thereby increase the flatness quality considerably. For this purpose both spot cooling, hot edge spray systems and inductive heaters are supported.

Spot cooling systems are used to reduce the relative reduction at specific "long" parts of the strip while the inductive heaters or hot edge sprays will remove "tight" edges by increasing the relative reduction at the strip edges. Dependent on their design there are different control applications available e.g. on/off, multi-step and pulse-length control. In order to maximize the effect of each cooling zone and get consistent operation, ABB also supplies an integrated coolant pressure control system.



# Direct and parallel measurement

## Make the difference

A flatness measurement system calculates the flatness from the measured force distribution on a measuring roll. Using the measured force distribution the ideal system must:

- accurately visualize the actual stress distribution of the whole strip.  
This includes edges, head and tail ends.
- within milliseconds and several times per rolled meter of strip, provide accurate outputs to the flatness control system.
- without any adjustments, be able to handle a wide range of products
- never affect the strip surface.
- fit in the mill easily and not cause any extra down-time during installation.
- never break down and it should not require any maintenance.
- be future-safe so it is easy to upgrade and to enhance functionality when so required.

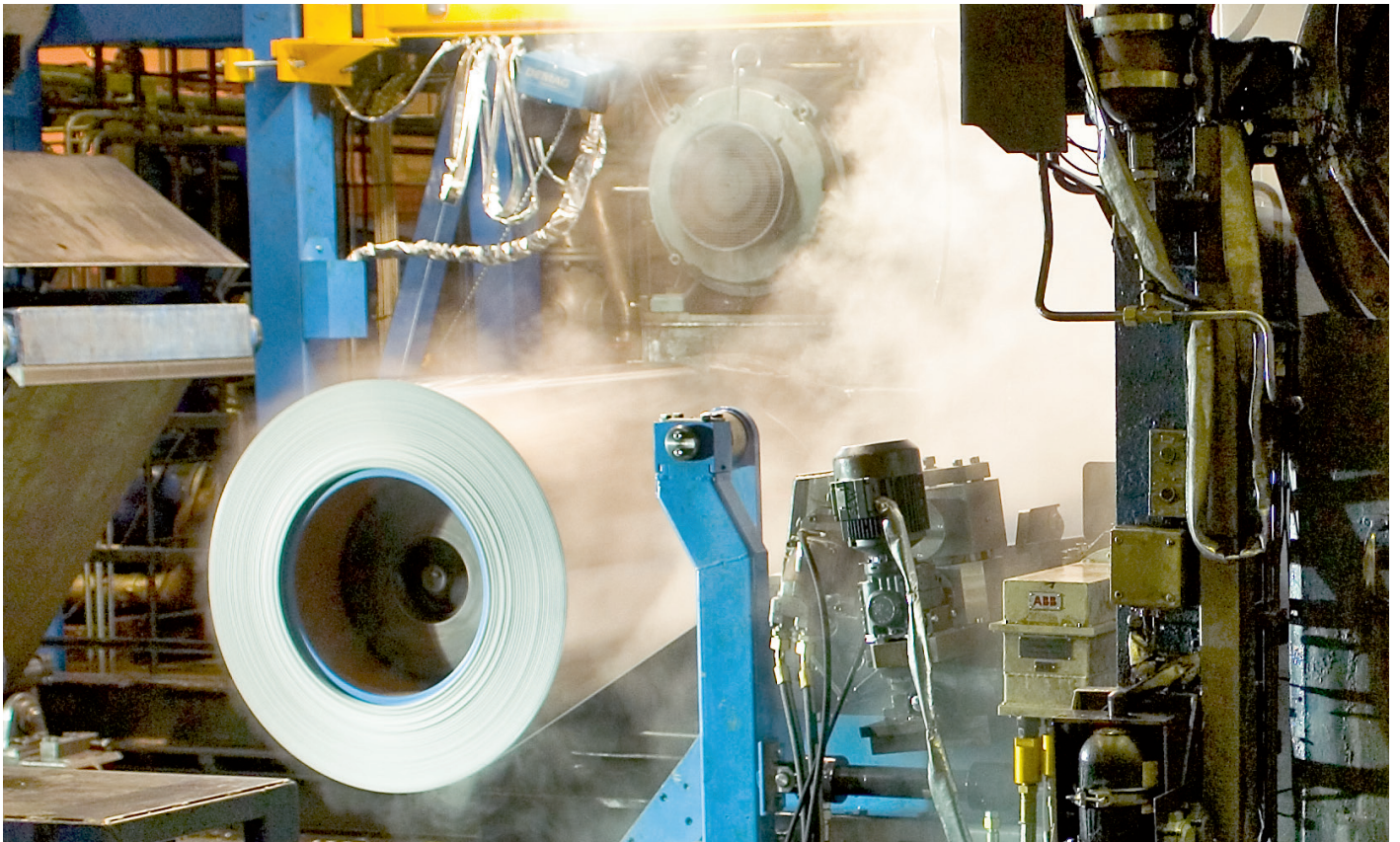
The features of the Stressometer Flatness Measurement System bring you as close to the ideal system as you can get with today's technology.

Features	Benefits
Durable Pressductor® sensor with allowable overload up to 240 000 N	Long-term stability – Roll MTBF (Mean Time Between Failures) more than 20 years
Measurement capability from 120 000 N down to 10 N per measurement zone	The same mill can be used for rolling both breakdown and finishing passes
Parallel measurement of force distribution	Insensitive to disturbances from strip tension variations
The output from the measurement zone is a completely linear function of the strip coverage of the zone	High accuracy with no compensation needed for partly covered zones
Measurement response time better than 5 ms	Provides fast and accurate output to the flatness control system
Measurement frequency 3–6 complete measurement profiles per meter of strip	High resolution measurement and control at any speed

Boost your mill with unsurpassed performance and accuracy:

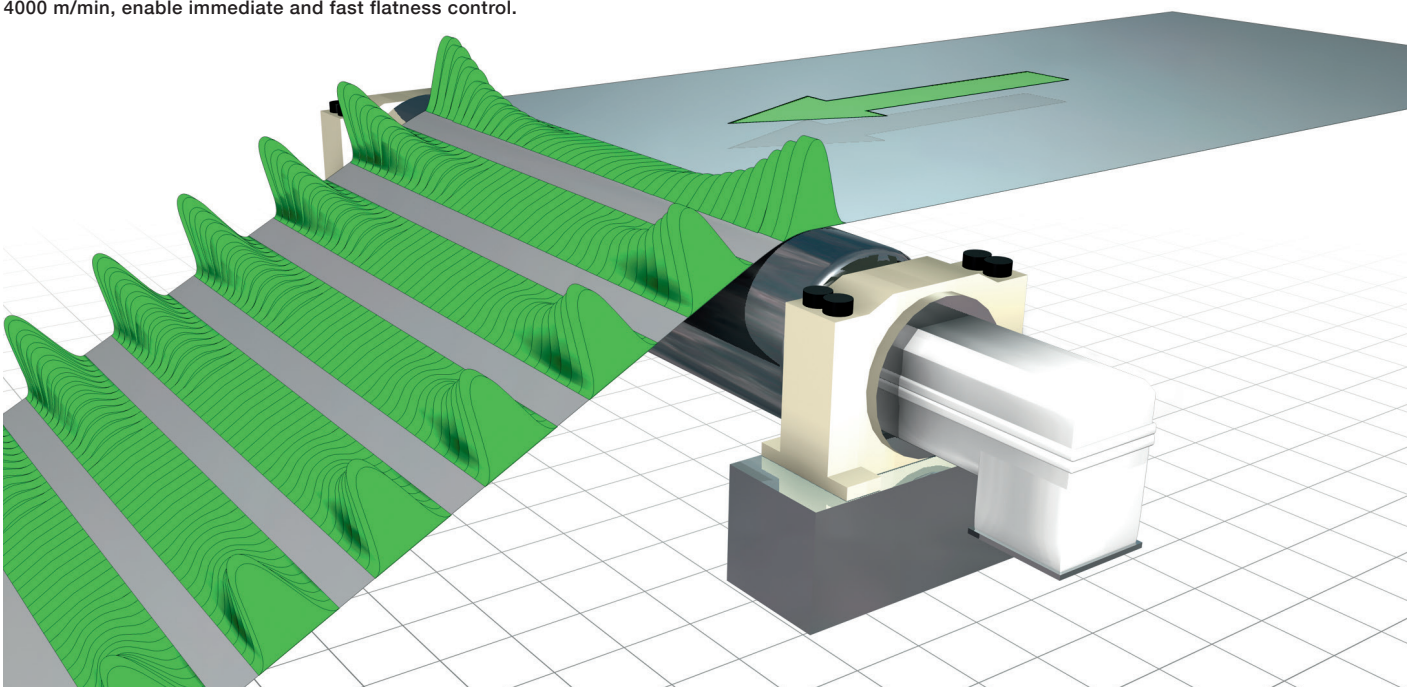
- Head and tail ends under full flatness control
- Faster acceleration and higher speed
- Strip edges under full flatness control
- Reduction of strip breaks





"After the Stressometer installation we can definitely justify the investment. Improved quality, higher speeds, shorter lead times, less transport and also productivity gain."  
Gränges, Finspång, Sweden

Four measurements per roll revolution, from start of rolling up to 4000 m/min, enable immediate and fast flatness control.





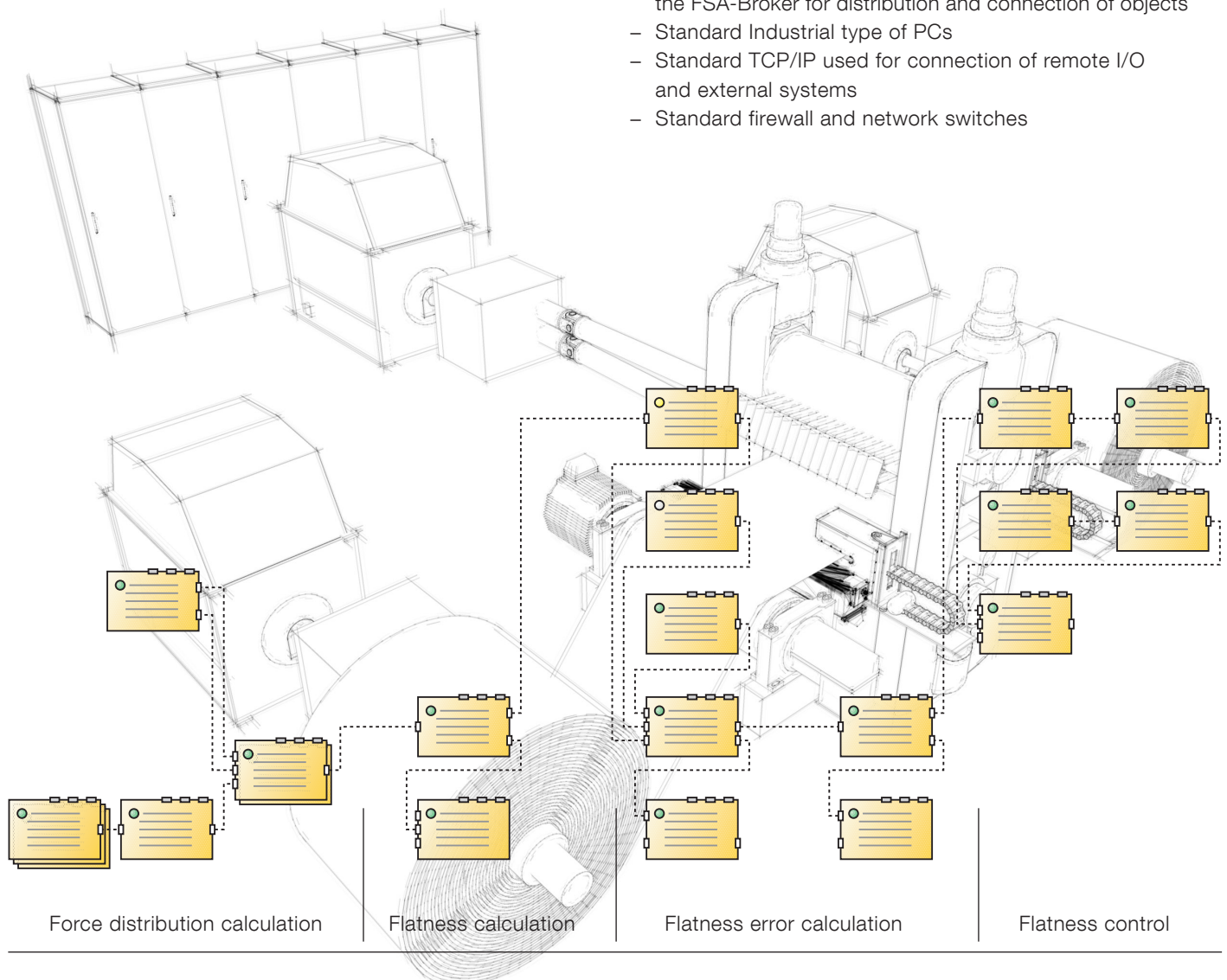
# Flatness Server Architecture

## A future-safe system makes the difference

A Flatness Control System is a long-term, often more than 20 years, investment for mill owners. It is therefore important that the system platform allows for continuous improvements, over the years, when the needs are growing.

The Stressometer system platform is based on internet standards. This means that the platform will follow the main stream of HW and SW technologies available on the market. Examples of technologies used are:

- Standard Internet browsers for HMI
- Java as programming language on system level, enabling platform independence
- Script language as programming language on application level
- Distributed object-oriented software architecture with the FSA-Broker for distribution and connection of objects
- Standard Industrial type of PCs
- Standard TCP/IP used for connection of remote I/O and external systems
- Standard firewall and network switches







"We are very happy with the Stressometer performance. The back-up rolls are in much better shape and they last much longer."  
SSAB, Hämeenlinna, Finland



"With good flatness in the galvanizing lines we have considerably less scrap and the previous problems with quarter-buckles and wavy edges have all been solved with the Stressometer installation."

Marcegaglia, Ravenna, Italy

"The good tail-out from the hot rolling mill results in high quality head-in to the cold rolling mill. We have increased the rolling speed, and the yield is also better then before."

Gränges hot aluminium mill, Shanghai, China



"The Stressometer has improved the product quality for the customer. The customer appreciates the good quality."



# Stressometer® supplementary products

## Full system integration for maximum performance

### Stressometer Flatness Logger for analysis and reports

The increasing requirements for signal analysis, quality control documentation and long-term storage records make the collection and evaluation/analysis of flatness data and quality vital.

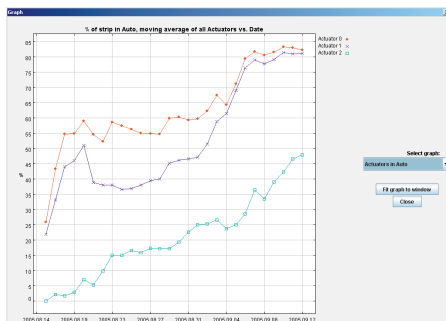
The Flatness Logger provides a separate, independent system for storage of actual flatness data.

The logger assembles strip data for every coil. Everything is stored in a data base, from which it is possible to provide a range of functions such as rapid overview of flatness report for each coil, possibility to make quality analysis over a period of time and the ability to generate a wide range of statistical analyses, including 3D diagrams of strip flatness. In addition, the Flatness Logger can make production reports over a period of time and analyze the quality in different views to increase efficiency and production.

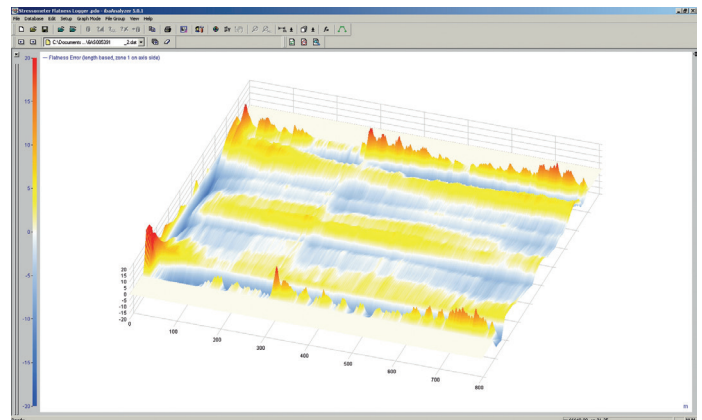
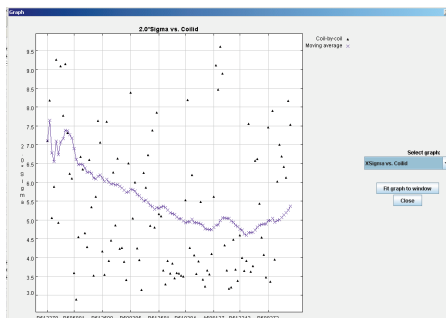


Quick summary of the coil quality with coil reports. With the Stressometer Flatness Logger you can generate reports of the data for each coil.

The graph shows, for each actuator, how much it has been in auto control mode during system commissioning.



The graph shows the flatness in I-units for each coil and the development of this value during the same system commissioning.



Strip flatness quality cannot be guesswork. With Stressometer Flatness Logger you can accurately monitor strip flatness and produce quality control print-outs of the data.



### Cooling system including coolant pressure control

Customized cooling system for each application covering:

- On/off spot cooling for carbon steel applications
- Multi-step spot cooling mainly for aluminium applications
- Pulse length spot cooling mainly for aluminium applications

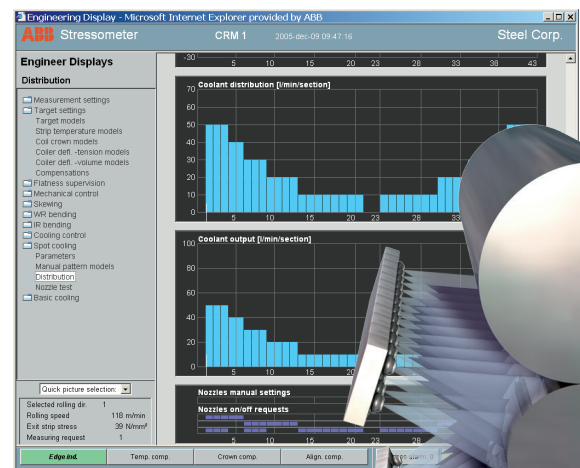
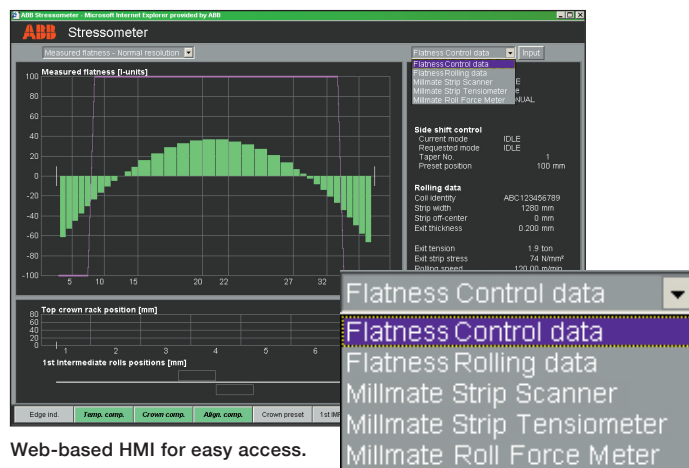
ABB supplies a complete cooling system integrated into the Stressometer System. It includes not only the spray headers themselves but also a coolant pressure control system.

The coolant pressure control includes a controller, a control valve and a pressure transmitter. In order to have a consistent operation of the sprays, the controller adjusts the coolant flow to keep the sprays constant.

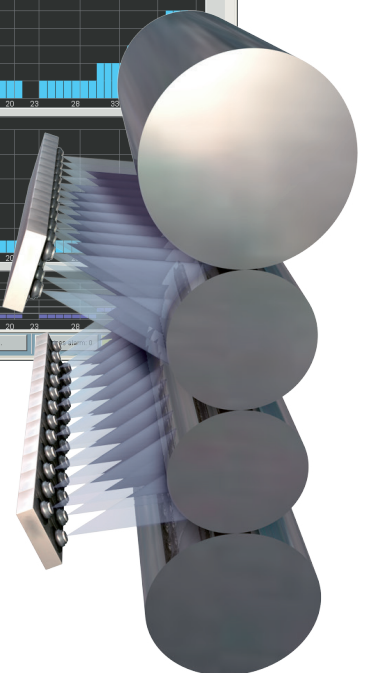
### Complete solutions for rolling mill

ABB has extensive experience and a high level of application know-how for the rolling mill industry. In addition to the Stressometer System ABB supplies a complete range of force and dimension measurement products and systems including:

- Millmate Strip Scanner Systems
- Millmate Strip Tensiometer Systems
- Millmate Roll Force Systems
- Millmate Thickness Gauging Systems



Cooling system including coolant pressure control.



# Contact us

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