



# TRANSFORMATION MONITOR

## ON-LINE MEASUREMENT OF STEEL TRANSFORMATION

The Transformation Monitor offers an on-line, non-destructive, and contactless measurement, of the phase transformation from austenite to ferrite within the steel strip.

As market demands increase many steel mills use modelling to determine the microstructure and therefore the final properties of the end-product. However, the model often relies on parameters and measurements that are not exclusively related to microstructure (e.g. temperature) which can result in inaccuracies.

To address this, Primetals Technologies offers a non-contact measurement system called the Transformation Monitor system. This uses an electromagnetic field, induced into the strip steel, to define the percentage of transformation and the microstructure and is installed along the runout table cooling zones.

### MAIN DESIGN FEATURES

- Direct and dynamic measurement of the ferrite concentration within the steel, as it cools
- Electromagnetic sensor (EMspec® based on research from Manchester and Warwick Universities) to exploit the changing magnetic properties of the transforming steel
- Transformation along the coil is displayed as a color-coded coil map
- The sensor head eliminates false signals resulting in accurate transformation reading
- Sensor response is independent of stand-off distance
- Sensor housing components are made from non-magnetic stainless steel

REAL TIME  
MONITORING  
SYSTEM

## CONSTRUCTION

One or more sensor heads are located under the pass line on the runout table. The sensor is only 250x140x30 mm and is encapsulated into a waterproof container. This is mounted into an environmental housing, which fits between specific roll gaps of the hot strip mill runout tables. The sensor housing has a water jacket, that provides a laminar flow around the sensor using the mill cooling water. The housing is capped off with a cover, just below the mill pass line. All the components of the housing are made from non-magnetic stainless steel.

The electrical connections to the sensor are via a high-grade military snatch inline connector system. Apart from the excitation and pickup coils in the sensor, there are connections for temperature monitoring and remote calibration controls.

## OPERATING PRINCIPLE

Each sensor head generates a primary magnetic field which interacts with the hot steel, producing a secondary magnetic field. Austenite has a low magnetic permeability, whilst ferrite has a high magnetic permeability, so the Transformation Monitor exploits this difference to measure the percentage of transformation that has occurred.

This breaks with the traditional approach of measuring the surface temperature of the steel on the runout table, where the scale or water on the steel surface produces temperature reading errors. The Transformation Monitor sensor head is constantly washed with water, to prevent false signals caused by material on the surface and give a stable and drift free sensor performance.

Another challenge in the transformation process is that certain grades do not fully transform to ferrite. The Transformation Index Measurement, which is part of the offered system, is a material-dependent measurement that calculates the ratio of austenite to ferrite in the final product. This advanced methodology results in accurate measurement through the strip length and delivers improved product quality control. This can also significantly reduce the time to market new steel grade developments.

The Transformation Monitor can be applied to new and existing mill model control, without any major change to the cooling process.



Transformation Monitor ready for installation



Transformation Monitor installed in the mill

## MAIN BENEFITS

- For installation in new and existing mills
- Modular design can be easily maintained even in difficult environments.
- Fully integrated sensor provides direct feedback to the mill's control system
- Real time monitoring, to allow operator intervention
- Consistent measurement, achieved when rolling dual phase, TRIP and TWIP products
- Desired microstructure achieved, avoiding expensive coil scraps
- Improved yield in high value steel production
- Huge cost savings, achieved through reduction in the micro-alloying elements
- Avoidance of strip surface damage

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Order No. T04-O-N096-L9-P-V4-EN  
Printed in Linz | © 2023

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